



THE HAND GRENADE

GORDON L. ROTTMAN





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Series Editor Martin Pegler

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INTRODUCTION

A German *Handgranatetrupp* (hand-grenade team) rushes across no man's land with each man carrying a pair of hand-grenade bags under his arms, 1917. The rightmost man carries a stick grenade in his hand. They are armed with Mauser 7.92mm Kar 98A carbines rather than the longer Gew 98 rifles carried by other German infantrymen. (Tom Laemlein/Armor Plate Press)

The hand grenade is essentially a technologically enhanced improvement of what was the first multifunctional, direct- and indirect-fire, offensive weapon employed in warfare – the rock. The hand grenade is basically a small missile filled with an HE or chemical agent intended for hand delivery against enemy personnel or material at short ranges. Over time such weapons have been supplemented by special-purpose grenades, which dispense irritant gas, incendiary effects, smoke screening, signaling, or target marking. The most utilitarian grenades are high-explosive/fragmentation (HE/frag or simply “frags”) – “casualty-producing” antipersonnel weapons. These are referred to as “defensive” grenades as they are intended to be thrown from behind cover. Another casualty-producing grenade is the blast, concussion, or “offensive” grenade. These



have bodies made of thin, light materials generating little fragmentation. They may be thrown from short ranges using minimal cover. The terms “offensive” and “defensive” with respect to grenades were coined by the French during World War I and the nomenclature has subsequently been adopted by many countries. As for practical employment, a soldier will use whatever type of grenade is available. Only “defensive” and “offensive” grenades are discussed in detail here, but these weapons’ role in the development of other types of hand grenade – and wider influence on related weapons such as the rifle grenade and the grenade launcher – is also covered.



During World War II, Soviet submachine-gunners take up position in a gully. In the foreground are three RGD-33 stick grenades without the customary add-on fragmentation sleeves, and two RPG-40 AT hand grenades. These relied on blast to buckle the armor and were not of the shaped-charge type. (Courtesy of the Central Museum of the Armed Forces, Moscow via Stavka)

Antipersonnel grenades rely on fragmentation and blast (flash burns, concussion, over-pressure) to inflict casualties. Fragmentation grenades have some form of construction that encourages the body to fragment effectively. The casualty radius can be 5–20m (5.5–22yd), but stray fragments can travel over 200m (219yd). Depending on the design and materials, there could be just a few large fragments or thousands. During detonation the cast-iron body actually swells almost to twice its original size. The explosion essentially pulls apart and shreds rather than shatters the grenade. “Controlled fragmentation” grenades were developed in the 1970s, consisting of thousands of steel ball bearings embedded in plastic bodies. The ball bearings, each 2–3mm (0.08–0.12in) in diameter, will travel only a short distance before losing their lethal velocity to reduce the danger to throwers. At close range, though, large numbers of ball bearings will strike targeted troops.

Hand grenades are relatively simple weapons. They must be, owing to the necessity of producing them in huge numbers at low cost while conserving essential materials, and the need to make them easy to use in the heat of combat. They are preferred to be lightweight, reliable, effective in their given role, and – foremost – safe for the user. This latter requirement means the user has to have confidence in the grenade’s reliability, the factory’s quality control, and the quality of the primer and delay fuse. Among the commonest of soldiers’ fears regarding grenades are concerns about poor quality control, poor workmanship, or use of inferior materials – resulting in delay fuses burning too fast, or causing the sparking primer to blast sparks that would bypass the delay fuse and ignite the sensitive detonator.

There have been many hundreds of grenade models fielded from World War I to the present. Additionally, there are innumerable variants of grenades, not just in functions and effects, but construction means and materials, safety mechanisms, arming methods, identification means, and how they are thrown. There are no unifying similarities between all



Vietnam, September 1965: a cautious "tunnel rat" of the US Army's 173rd Airborne Brigade grips an M26 grenade as he examines a Viet Cong bunker. At the slightest sound from within he will lob the grenade, often followed by a second. Smoke and tear-gas grenades were also used to flush out the enemy. (Tom Laemlein/Armor Plate Press)

grenades unless it is the fact that they are hand-thrown. Making assumptions that any two grenades function similarly can be fatal. Grenades require a prescribed manner of delivery to ensure proper employment, maximal effects upon the recipient, and safety of the user. By the nature of their design most hand grenades are readily adaptable as booby traps or early-warning devices. Grenades can be used offensively or defensively. Other than that, there is little in the way of grenade tactics as such. It is a weapon operated by a single combatant, although grenadiers most effectively work in pairs, with the second man providing security. However, during World War I more

elaborate grenade tactics evolved employing specially trained and equipped teams to attack and defend trenches.

World War I is considered the "golden age" of grenades as there were so many successful and less-than-successful types fielded in effort to provide the massive numbers demanded. This included "trench-made" or expedient grenades of questionable safety. By the war's end the modern grenade had emerged from hard-learned lessons. Since World War I the grenade has been viewed as the infantryman's "pocket artillery," the shortest-ranged weapon in a succession of high-explosive/fragmentation-firing weapons ranging progressively upward to rifle grenades, mortars, howitzers, and guns. During the interwar years some improvements were made on fragmentation grenades and a few new special-purpose types were developed. Impact-detonated fuses were looked at during the 1930s, but these proved dangerous to the user. Generally unsuccessful attempts were made to revive them during World War II and again in the 1960s.

By the outbreak of World War II most armies were employing effective grenades and that conflict saw the use of a wide range of grenades, including fragmentation, blast, antitank (AT), incendiary, screening and signaling smoke, various chemical, and others. They were expended in huge numbers in all theaters. For example, the US produced 87,320,000 hand and rifle grenades during World War II. Most countries could not keep pace with the demand. Countries *in extremis* fielded expedient grenades using substitute materials and inferior components. Hand grenades that could be fired from rifle grenade launchers emerged. Grenades were commonly adapted as booby traps. Since 1945 grenades have been improved in reliability, more powerful explosives, and more effective fragmentation. Regardless of the introduction of high-tech weapons, grenades have remained essential. Development of course continues, but today's grenades for the most part represent the pinnacle of development in this line of ordnance.



DEVELOPMENT

A universal weapon

ORIGINS

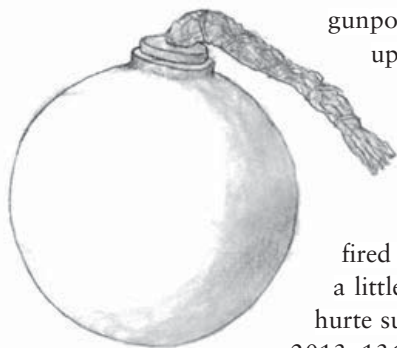
First recorded in the 8th century AD, the earliest grenades were Byzantine incendiary weapons, employing the mysterious “Greek Fire,” akin to modern napalm. In the ensuing centuries the technology spread through the Islamic world and into the Far East, with the Chinese refining the weapon to feature a metal casing and a gunpowder filling. By the 16th century the weapon had entered military service throughout Europe, and grenades were cast-iron spheres 4in or larger in diameter with a time fuse fitted – reminiscent of those carried by cartoon spies. Instead of waxed candle wicks, the fuse was now a flaxen cord rolled in dampened



By the late 17th century most European armies included assault units of infantrymen specially trained to throw grenades. Dated 1744, these watercolours by Andrew Lens (c.1713–after 1779) depict stages of a British grenadier’s drill movements. Grenadiers were selected from among the largest, strongest, and bravest soldiers to lead assaults and hurl grenades at the enemy’s positions in advance of the main body. The attacking grenadiers carried lit “slow matches” – slowly burning fuses from which to light grenade fuses. (Anne S.K. Brown Military Collection, Brown University Library)

An example of the types of grenades used from the 1600s all the way to World War I – a cast-iron sphere filled with gunpowder and fitted with a thread-wrapped cotton wick rolled in dampened gunpowder or sulfur and dried. The term “grenade” is variously said to be derived from the Latin word for pomegranate, *pomum granatum* (meaning “apple” and “seeded”), or the Spanish word for the same fruit, *granada*, owing to the size and shape of early spherical grenades.

“Pomegranate” in French is *grenade* while a pomegranate bush is a *grenadier*, which is also the French term for a grenade-thrower. To differentiate a pomegranate from a French hand grenade, *grenade à main* is used for the latter. The word “grenade” is also said to be derived from the Latin term for grain (as in corn), *granum* – a less likely name source. This may have referred to the coarse-grain gunpowder used as explosive filler in early grenades, which was described as “corn grains.” The English originally referred to the grenade as a “grenado” at least into the 1700s. During World War I, though, the British simply referred to their grenades as “bombs.” This originated from The Grenadier Guards protesting that grenade-throwers throughout the Army were being called “grenadiers,” an infringement of the regiment’s privileges. In 1916, King George V subsequently ordered they be called “bombers” or “bomb throwers.” Today, many European countries use a term derived from *granat* with variants in spelling. Italy uses *bomba* (pl. *bombe*), but colloquially uses *granata* (pl. *granate*). Note that “grenade” can also refer to HE projectiles or cannon shells in some languages, for example the German *Granat-Geschoß* (HE shell) or *Granatwerfer* (grenade projector – a mortar firing HE rounds). (Author)



gunpowder and dried. Grenades weighed up to 2.5lb and sometimes more. This was to be the standard design for the next 300 years. According to Peter Whitehorne, one observer of the European military scene in the 1570s: “These balles, after they are fired and well kindeled, and having blown a little, must be quickly throwen, lest they hurte such as hurtle them” (quoted in Heinl 2013: 136).

In the 1700s, the British used 3lb and 6lb grenades filled with 3oz and 5oz of gunpowder, respectively. Explosive grenades were also used aboard ships for boarding and repelling boarders. Lighter and less costly than cast-iron grenades, thick tempered-glass spherical grenades appeared in England in 1685 and were used up to the 1850s to enhance fragmentation effects. Cast-iron grenades often broke up into only a few large pieces, resulting in insufficient casualties. The explosive flash of a gunpowder detonation also caused casualties – burns and internal concussion injuries, especially within trenches and enclosed fortifications.

Although the term “grenadier” continued in widespread usage – normally denoting elite troops – by the time of the Napoleonic Wars (1796–1815) such soldiers generally eschewed the weapon that had prompted their designation. Grenades were essentially siege weapons, being used mainly by defending troops, who threw them into approaching sapper trenches and the ditches surrounding besieged fortresses. Attackers sometimes employed them, however; in 1836 the Mexican Army employed grenades at the Alamo, and grenades were used by all sides during the Crimean War (1853–56) and the American Civil War (1861–65). Following the British use of grenades in the Sudan during 1884–85, homemade grenades were used by besieged British forces during the Second Anglo-Boer War (1899–1902). A British artillery manual of the 1880s offers a brief comment of the intended purpose and nature of such weapons: “[Grenades] are used chiefly for the defence of places against assault, being thrown among the storming parties in the ditch. They are useful in the defence of houses. They can be thrown by hand about 20 or 30 yards. They are of two sizes, 6-pr and 3-pr” (Anon 1887: 78).

As with so many aspects of warfare, it was the Russo-Japanese War (1904–05) that provided the world with clear indications of the potential of the grenade as a mass infantry weapon. During the Japanese siege of Russian-held Port Arthur, grenades were extensively used by both sides. The Russian defenders were the first to employ them, using old cannon balls – or brass artillery cartridges cut into 4in lengths – filled with dynamite; to prevent premature detonations a mining safety fuse was attached, as it did not spark as much as the earlier type. The Japanese besiegers used meat tins, pottery jars, and bamboo sections filled with a pound of pyroxylin or picric acid (two early military explosives). Attacking Japanese grenadiers even carried burning slow matches to light grenades like the earliest grenadiers. The Japanese appear to have been the first to add handles to grenades to

increase their throwing range; they also used fabric stabilizing streamers to improve grenade accuracy. The Russians provided standardized instructions for fabricating grenades, and the Japanese mass-produced grenades on-site using cast-iron pipe. Besides defensive use, both sides employed grenades to “open gaps” in crowded enemy trenches, allowing friendly assault troops to use their bayonets. Grenades were also used to clear rooms during village fighting, portending one of the weapon’s principal uses during World War II.

The Italo-Turkish War (1911–12) saw the use of grenades in the first documented instance of explosive devices being dropped from an aircraft. An Italian flyer, Sottotenente Giulio Gavotti, armed four *cipolla* (“onion”) grenades, lit them, and dropped them on Ottoman positions in Libya on November 1, 1911. The bombs were orange-sized, 4lb iron spheres filled with potassium picrate and fitted with a safety fuse – akin to the grenades of the 1700s. They inflicted no casualties. What can be considered the first modern percussion grenade, however, had been developed in 1903 by Miloš M. Vasić, an officer of the Serbian Army. After further refinements, his design saw service as the M.12 or “Vasićka” during the First and Second Balkan wars (1912–13).



The American Civil War saw a reemergence of grenades, mainly for defensive use. These were of more advanced design than the previous iron ball with a fuse, as they now had mechanical fuses. The Ketchum grenade – pictured here lacking its stabilizing wooden tailpiece with fins – Hanes “Excelsior” grenade and Adams grenade were quite innovative, but were complex, costly, and dangerous to users owing to their sensitivity. Confederate soldiers mixed gunpowder and musket balls in fused glass bottles and Union soldiers used 6lb cannon balls as grenades. (CC BY-SA 3.0/ Minnesota Historical Society)

GRENADE COMPONENTS

Grenade bodies

The grenade body contains the filler (explosive, chemical, or pyrotechnic). It can be various shapes: an oval (egg or lemon), a sphere (ball), a cylinder (can), or a truncated cone (a cone with the apex cut off). A sub-class of grenades is the stick grenade or “potato-masher,” fitted with a throwing handle. The body also serves to attach the fuse, arming, and safety systems. A fuse well is usually in the grenade’s top and a filling or charging hole in the bottom, side, or near the top. The fuse well and filling hole may be the same. Most grenade bodies are made of cast iron or thin, one- or two-piece pressed sheet steel or tinplate. The seams of rolled metal body grenades are crimped and/or soldered. Other materials include aluminum, tinplate, brass, Bakelite (plastic-like synthetic resin), plastic, glass, compressed fiber, treated paper, cardboard, ceramic, and even concrete and wood. The last three were *in extremis* substitutes because of the lack of more viable materials. The segmentations cast in the body do little to create fragmentation and are provided to ensure a firm grip with wet or muddy hands. Modern plastic-bodied grenades have external ridges for the same purpose. Very seldom are internal segmentations used, but this does aid in fragmentation.

A Serbian M.12 grenade. It was one of these that was thrown by Nedeljko Čabrinović, a young Bosnian Serb nationalist, at the car containing Habsburg Archduke Franz Ferdinand in Sarajevo on June 28, 1914; the 10-second delay meant it missed its target, but wounded 20 bystanders. The archduke was killed later in the day to start the sequence of events that sparked World War I, a conflict in which grenades would become essential defensive and offensive weapons. (© IWM MUN 3261)





To the left are the larger fragments including the base of a British No. 36M Mills Bomb. To the right are fragments from a US M67 grenade. These are only a fraction of the fragments generated from both types of grenades, most of which were much smaller. A Canadian 10-cent coin (0.71 in in diameter – slightly larger than the US 10-cent coin) is included for scale. The author has found US Mk 2 “pineapple” grenade fragments on grenade ranges with 2–6 segmented sections still in a single piece. Some antipersonnel blast grenades were provided with steel fragmentation sleeves that slipped onto the body, converting them from blast to fragmentation. Enhanced fragmentation means is incorporated in many post-World War II grenades – internal fragmentation liners in thinner bodies or coiled steel wire scored at intervals. Smooth cast- or sheet-metal bodies do provide some degree of fragmentation, but the few fragments are too large, irregular in size, or too small and light to be lethal. (Courtesy of Darryl W. Lynn, the Grenade Recognition Manual-series)

Grenade fillers

A grenade’s filler defines its purpose(s). Fillers include high explosives (HE), chemical (smoke, incendiary, irritant gas), and pyrotechnic (flares, smoke). HE fillers are intended to shatter grenades to produce fragmentation and blast effect. The shattering effect is called brisance. The relative effectiveness of common grenade explosives is compared to TNT (trinitrotoluene), which has a value of 1.00.

On its own, **ammonium nitrate** is comparatively low-powered. To make it more effective it was mixed with additives. **Alumatol** consisted of 77 percent ammonium nitrate, 20 percent TNT, and 3 percent powdered aluminum. Another was British **Burrowite**, with 74 percent ammonium nitrate, 16 percent TNT, and 10 percent powdered aluminum. French **Schneiderite** was composed of 88 percent ammonium nitrate and 12 percent dinitronaphthalene. Ammonium nitrate-based explosives disappeared after World War II because of the development of more advanced explosives. Owing to shortages of materials during World War II, **black powder** saw limited use as a substitute filler by the Germans, as well as being employed as a starter compound. It is made from 75 percent potassium nitrate (“saltpeter”), 15 percent sulfur, and 10 percent charcoal. It is highly susceptible to moisture, but once dried, will ignite. **Picric acid** was one of the earliest military HE types and was used by France, Germany, and Japan from the 1880s. It reacts with metals when moist to form sensitive compounds. This required the inside of grenades to be varnished. It is more easily detonated than TNT, but resists shock to about the same degree.

TNT is one of the most widely used explosives, coming into use after 1900. It is a component of many other explosives (amatol, pentolite,

tetrytol, baratol, Torpex, tritonal, picratol, ednatol, Comp B). Stable and insensitive to blows, TNT requires an explosive shock to detonate it. **Amatol** is a mixture of ammonium nitrate and TNT. The first number always indicates the percentage of ammonium nitrate and the second, TNT. Amatol is insensitive to friction, but may be detonated by severe shock, being less sensitive than TNT. Amatol 80/20 is slightly less powerful than TNT and produces white smoke. Amatol 50/50 explodes with slightly higher force than TNT. **Comp B** appeared late in World War II and is still widely used in grenades. A combination of 59 percent RDX, 40 percent TNT, and 1 percent beeswax, it is very stable and one of the more powerful explosives.

EXPLOSIVE EFFECTIVENESS

ammonium nitrate	0.42
black powder	0.55
picric acid	1.00
TNT	1.00
amatol 50/50	1.20
tetrytol 75/25	1.22
tetryl	1.28
Comp B	1.33
PETN	1.42
RDX (hexogen)	1.60

Grenade fuses

A grenade's fuse is the most critical component in regards to safety and reliability. While grenades are comparatively simple munitions, their fuses can be quite complex. They include: safety and arming pins; arming levers; covers; spring-loaded firing pins and strikers; arming plungers and setbacks; igniters; primers; delay fuses (delay train); flash tubes; detonators; booster or bursting charges; and starter compounds – assembled in a functional housing to hold it in the grenade. Grenades are fitted with some form of delay-train fusing, usually 4–6 seconds plus or minus a half-second. A 15 percent timing tolerance is customary. The delay must be long enough to ensure the grenadier's safety and allow it to be thrown to the maximum range, but not so long a delay to allow the enemy to return it.

The **lever-release fuse** is activated by pulling an arming pin, a cotter pin, and releasing a safety lever, AKA “spoon.” It detonates after a set time initiated by the activation of a “mousetrap” striker hitting a primer and igniting the delay train. Originally a World War I French design, it is commonly called the “bouchon-type” igniter, a term derived from the French M1916B automatic igniter (*bouchon allumeur automatique*). *Bouchon* means plug or stopper, describing the fuse as fitting in the top of the grenade as a plug in a bottle. Since World War II this has become the most widely used fuse. A second type of lever-release fuse uses a spring-loaded firing pin in a vertical tube-like housing. It is held in the cocked position by the arming pin. When pulled, the end of the arming lever continues to retain the firing pin. When the lever is released, the pin plunges downward to strike the primer. The **pull-igniter fuse** has a cap that is unscrewed to expose the pull-igniter – a ball or ring on a cord. It is pulled and the match-like friction igniter activates the delay train. This

During World War II, an SS-*Oberscharführer* of Nazi Germany's Waffen-SS inserts the No. 8 detonator into the upper end of the handle of an Stg 24. The cord attached to the friction igniter with its porcelain ball dangles from the handle's lower end. The cord and ball will be inserted into the handle and the metal end cap screwed on. (Tom Laemlein/Armor Plate Press)



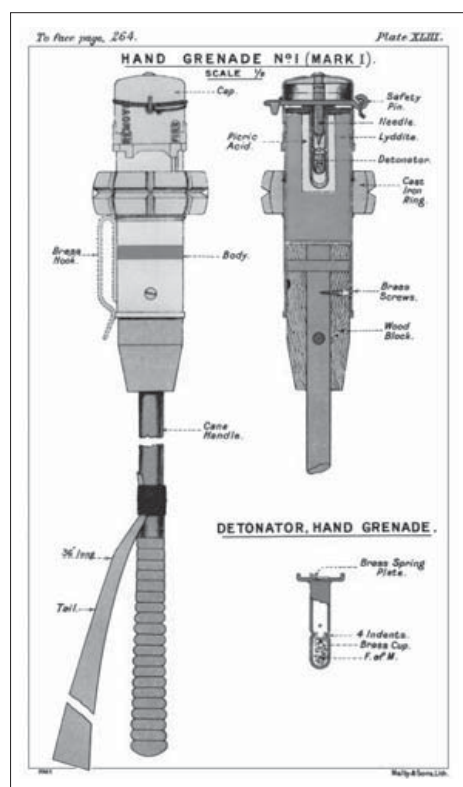
The British No. 1 Mk I percussion pattern grenade. Monsieur B. Pedersen of Belgium had patented a rod-type rifle grenade in 1905. This influenced a design by Marten Hale of Britain, patented in 1908. The Royal Laboratory at Woolwich Arsenal undertook to develop a similar grenade while avoiding patent fees. 22in long, the new grenade was similar in design and functioning as Hale's rifle grenade, but the No. 1 Mk I was hand-thrown. As it was necessary for the rifle grenades to impact nose first, the No. 1 hand grenade had a 16in cane handle with braid stabilization streamers, but the handle made it dangerous to throw, owing to the high probability of the impact-detonated grenade striking a trench's parapet (rear parapet). Some troops refused to use it, or even the shorter handled (8.5in) No. 1 Mk II. (*Treatise on Ammunition*, British, 1915)

type of igniter has a high failure rate owing to the igniter failing to light the pyrotechnic – no second pull is possible. It is highly susceptible to moisture. The **percussion-igniter fuse** has an arming pin that is removed to free an internal firing pin. The fuse is sharply rapped on a solid object (helmet, boot heel, rifle stock, rock), releasing the firing pin to strike a primer and igniting the delay.

In contrast, the impact-detonated grenade does not have a delay fuse. An arming pin is pulled and a safety lever or cap released when thrown. This arms an “**all-ways**” **impact fuse**, which instantaneously detonates when it impacts. Such weapons were unpopular because if accidentally dropped they immediately exploded or exploded within lethal range of the thrower if striking nearby vegetation. They were unreliable and did not always detonate upon impact, resulting in sensitive, armed duds. Due to their danger and questionable reliability, they saw little use. At different times there have been attempts to develop safe, reliable impact-detonated fuses, but they remain dangerous.

HAND GRENADE DEVELOPMENT

The following grenades are examples of the hundreds of models fielded over the past century. The descriptions focus on antipersonnel grenades, but include examples of some of the more notable other types.



British hand grenades

The British developed scores of antipersonnel grenades, but only the most widely used are addressed here. Commonwealth nations used British grenades and often produced them. When the British Expeditionary Force (BEF) arrived in France in August 1914, it was prepared for mobile warfare, not for troops peering across tangled barbed wire and a cratered sea of mud. There was a sudden rush to develop trench-warfare weapons. Hand grenades were among these. The BEF did possess a grenade, the **No. 1 Mk I percussion-pattern grenade**, adopted in 1908. Besides being slow to produce, it proved dangerous. Since it was armed after the pin was pulled and impact-detonated, the grenade exploded when it struck an object. When held by the long handle and the arm swung back to throw, it could strike the trench's rear parapet. This led to a general refusal to use them. The **No. 1 Mk II** had an 8.5in handle and other improvements, but it still met with accidents. By the end of 1914 production had reached 70 grenades per week, enough for a single trench raid. It is no wonder that “trench-made” grenades were produced by the troops, a dangerous undertaking in both

manufacture and use. According to one “recipe”: “Take a jam-pot, fill it with shredded guncotton and ten penny nails, mixed according to taste. Insert a No. 8 detonator and a short length of Bickford’s Fuze. Clay up the lid. Light with a match, pipe, cigar or cigarette, and throw for all you are worth” (quoted in Holmes 2005: 386).

The scene shifts to Belgium where in early 1914, Albert Dewandre of Compagnie Belge de Munitions Militaire and Capitaine Léon Roland of the Belgian Army co-designed a grenade with an automatic fuse igniter activated when an arming pin was pulled. It also incorporated an arming lever for further safety. The delay train and detonator were contained inside the grenade. Roland was taken prisoner in November, leaving Dewandre to press on with the grenade’s continued development. The resulting Roland grenade was a segmented sphere. It was complex and expensive, with multiple internal chambers for the involved fusing system. It also had fragmenting segments cast inside, which was unusual. In January 1915 William Mills, the innovative owner of two metal-forging plants, made arrangements with the British War Office to fabricate four Roland grenades and help evaluate them. On January 26, Dewandre armed and threw the grenades, which failed to function properly. The War Office rejected the Roland as unreliable and unsafe. Mills further developed the design and produced drawings in early February. The first proposed design was cylindrical rather than the Roland’s sphere or the oval shape later adopted by Mills. It had external segmentations, but Mills stated they served to provide a firm grip with wet or muddy hands. Prototypes were tested on February 20, 1915. With a few modifications, the **Mills Bomb** was soon in mass production. Roland had applied for a patent in Britain in August 1913 and it was accepted in December that year. Mills’ patent application was filed in February 1915 and accepted in December. After the war there were subsequent patent disputes, which were never fully resolved. Even so, the Mills Bomb is considered the longest-serving grenade anywhere in the world, seeing use into the 1990s, and may still be encountered.

The first orders for 50,000 Mills Bombs were placed with Mills Munitions Ltd and two other firms in late March 1915. Eventually, 20 other companies produced the 75 million Mills Bombs of all marks supplied to the British and Allied armies. A small batch was sent to France for combat testing in March, and larger numbers were available by May. It was not until September 1915 that significant numbers were arriving at the front, in time for the battle of Loos. The demand for grenades was so great that “trench-made” grenades remained in use and the War Office accepted other models, not only to supply the vast numbers needed, but always in search of more effective and safer models. The Mills Bomb retained its reputation and became the standard grenade after the war.



A No. 5 Mills Bomb, manufactured in September 1915. The Mills’ body had a small filler hole near the top and a sparking-prone percussion fuse inserted from the base and secured by a base plug. The fuse consisted of a vertically aligned tube containing a spring-loaded striker. When the arming pin was pulled and the grenade thrown, the striker lever flew off, releasing the striker. It struck a cap on the end of a J-shaped delay fuse. The igniter set consisted of a cap, cap chamber, delay fuse, and No. 6 detonator. This was the common design for all marks with minor differences. No. 5 production ceased in March 1918. (© IWM MUN 3207)

The first Mills Bomb was the **No. 5 Mk I**, approved in May 1915. The **No. 23 Mk I**, offering minor refinements, began production in July 1916. The **No. 23M Mk I** had improved sealing and explosive fillers better suited for storage in the tropics. “M” referred to Mesopotamia, a hot-wet tropical region in Iran and Iraq. The **No. 23 Mk II** and **No. 23M Mk II** had additional improvements to the fuse. The **No. 23 Mk III** and **No. 23M Mk III** were substantially redesigned, having a larger filler hole slightly lower on the body, a recess for the arming lever, differently shaped lever brackets, and the base plug redesigned for improved tightening, plus additional improvements to the fuse and sealing.

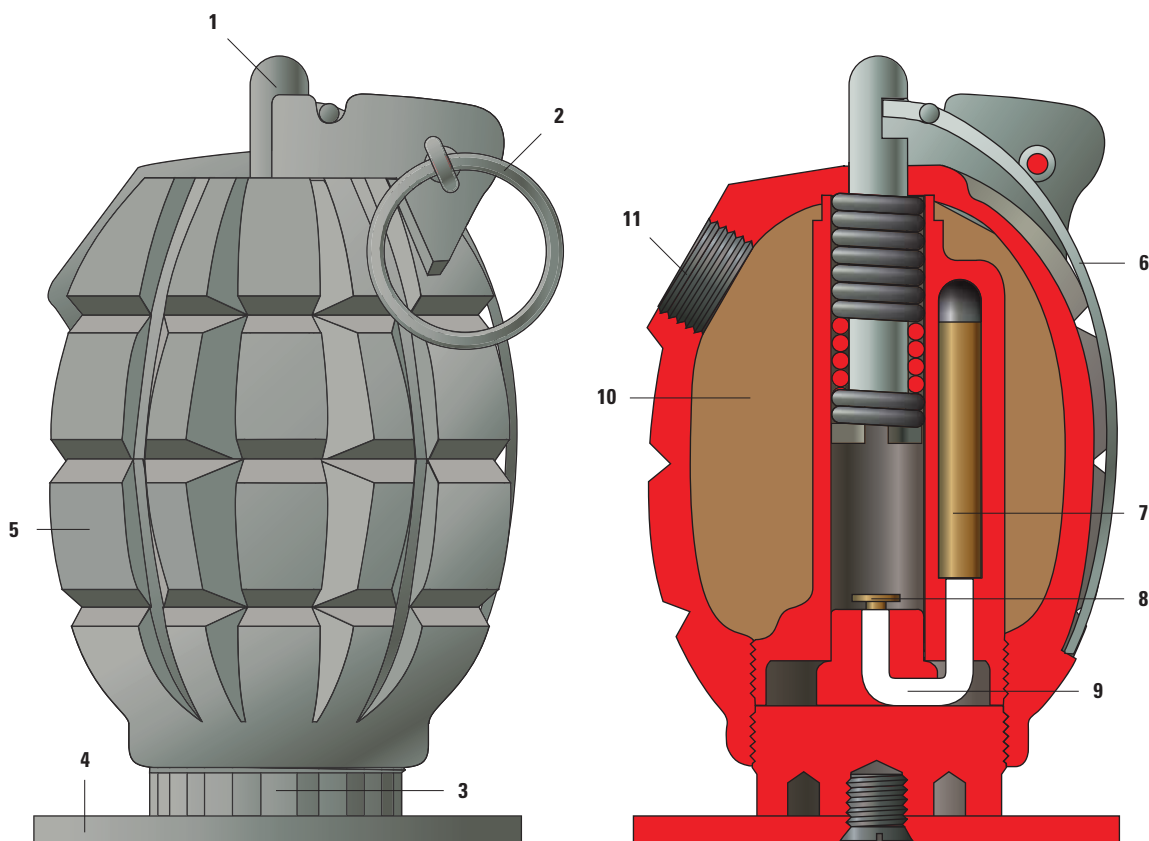
The **No. 36 Mk I** was introduced in May 1918, a slightly modified **No. 23 Mk III**. The fusing was improved and changes made to speed manufacture. 4in high and 2.4in in diameter, it remained standard until December 1923. The **No. 36M Mk I** had been introduced in March 1918. In 1923 it was decided that all grenades should be better sealed and contain explosives better suited for long-term storage in any climate. The **No. 36M Mk I** became the standard Commonwealth grenade, simply known as the “No. 36.” The main difference between the **No. 36** and **36M** and the **No. 5** and **23** was that a 2.5in-diameter Mk I “gascheck” disc could be screwed into the base plug for the later two models. This allowed it to be launched from the 2.5in **No. 1 Mk I** grenade discharger on the Lee-Enfield rifle, AKA the “E.Y. discharger” – Edward Yule was the designer. The **No. 36M**, while remaining in use, was no longer used as a rifle grenade after 1945, but not declared obsolete as such until 1962.

The Mills was 4.75in long and 2.3in in diameter. It weighed over 1.5lb, with just over 2oz of explosive: alumatol, ammonal, amatol, Bartol, Bellite, Cilferite, Sabulite, or Trotyl. The bodies were shellacked brown inside and out to prevent rusting and chemical reaction with certain explosives. Amatol-filled grenades had a green band around the body and grenades filled with alumatol, ammonal, or Bellite had a pink band. All had a red band around the top, indicating they were filled. All Cilferite-filled grenades were destroyed at the end of 1932 as unsafe and from 1936, Trotyl was no longer used. Post-war Pakistani grenades were filled with TNT. **No. 36** grenades were painted service brown (dark brown). **No. 36M** grenades had a row of red Xs in lieu of the red band.

The **No. 5** and **23** grenades both had 5-second delays, to include the **No. 23** when launched from a rifle. The original **No. 36** and **36M** had 7-second delays when used either as a hand or rifle grenade. Gaschecks and discharger cartridges were packed with the grenades. In 1940, the BEF in France complained that this long delay allowed the enemy to throw grenades back. From 1941, 4-second igniter sets were issued in the boxes for hand-thrown grenades while 7-second sets were issued along with gaschecks for grenades intended for firing from dischargers. These could still be used as hand grenades if necessary. The boxes were marked “Hand Grenades 4 secs” or “Discharger Grenades 7 secs.” **No. 36Ms** were made in India with instantaneous detonators for use as booby traps. The detonator set was painted red and the top of the cap chamber was knurled so it could be identified at night. A tag stated “This grenade **MUST NOT** be fired from a rifle or thrown by hand.” Australia fielded the **blast**

THE MILLS BOMB EXPOSED

British No. 36M Mk I hand grenade



No. 36M grenades were employed by all Commonwealth forces in World War II, Korea, Malaya, Borneo, and other conflicts. They were used by Free Polish forces in France and Italy. Some have turned up in Iraq and are still encountered in remote parts of the world. Many were supplied to French, Italian, Yugoslavian, and other partisans by the Special Operations Executive, while the German Abwehr provided them to its own saboteurs in Italy. It was produced by Britain, Australia, Canada, India, New Zealand, and South Africa. British and Australian production continued until 1972. They were still being made in India and Pakistan at least into the 1980s as well as Indonesia. Former UK protectorates continued their use long after the war. They were used by Australian forces until 1976 but not in Vietnam, where the

"Diggers" were armed with US grenades. Mills were used by Ireland and various African, Middle Eastern, and Asian countries. Owing to grenade shortages in Papua during the battle of Buna–Gona (November 1942–January 1943), US troops were issued Australian No. 36Ms to make up for shortages of their Mk II grenades (see below). In an early 1943 survey, 78.6 percent of US 32nd Infantry Division soldiers preferred the Mills over the Mk II owing to its more powerful blast. The Mills had 2.437oz of filler while the Mk II had 1.85oz. The Mills also fragmented more effectively. Casualty radius was about 20yd, with large fragments traveling up to 100yd. A Mills detonated in a test chamber generated almost 500 fragments, ranging from tiny bits to inch-long shards.

1. Striker
2. Safety pin
3. Base plug
4. Mk I gascheck disc (for use as a rifle grenade)
5. Cast-iron body
6. Safety lever
7. No. 27 detonator
8. 22-caliber percussion cap
9. No. 17 fuse (7-second delay)
10. Ammonal, alumatol, amatol, or Ciferite filling
11. Filling-hole plug

A collection of hand grenades along with 40mm under-barrel grenade-launcher rounds to be issued to a British section (squad) in Afghanistan, 2007. The larger, light-green grenades are L70A1 red signaling smoke grenades. Other colors are L68A1 green, L69A1 orange, and L71A1 blue. The smaller, dark-green grenades are L84A1 red-phosphorus screening smoke grenades. Red phosphorus is safer than white phosphorus and also burns white. The spherical grenades are L109A1 fragmentation grenades, based on the US M67. (© IWM HU 104270)



attachment Mk I and **blast bomb Mk II**, cans almost twice the size of the No. 36M filled with TNT and ammonal, respectively, and attached to the bottom of grenades for attacking fortifications.



Complementing the F1, the OF M1915 offensive hand grenade with an M1916B fuse was used during World War I and early in World War II. It had a thin, stamped-steel body and no fragmentation liner, and could be fitted with the same fuses as the F1. Filled with 150g (5.29oz) of Cheddite, it weighed 250g (8.82oz). Being lighter than the F1, it could be thrown farther. The example shown here is blue-gray in color, as used during World War I. Later examples were all yellow. (© IWM MUN 3224)

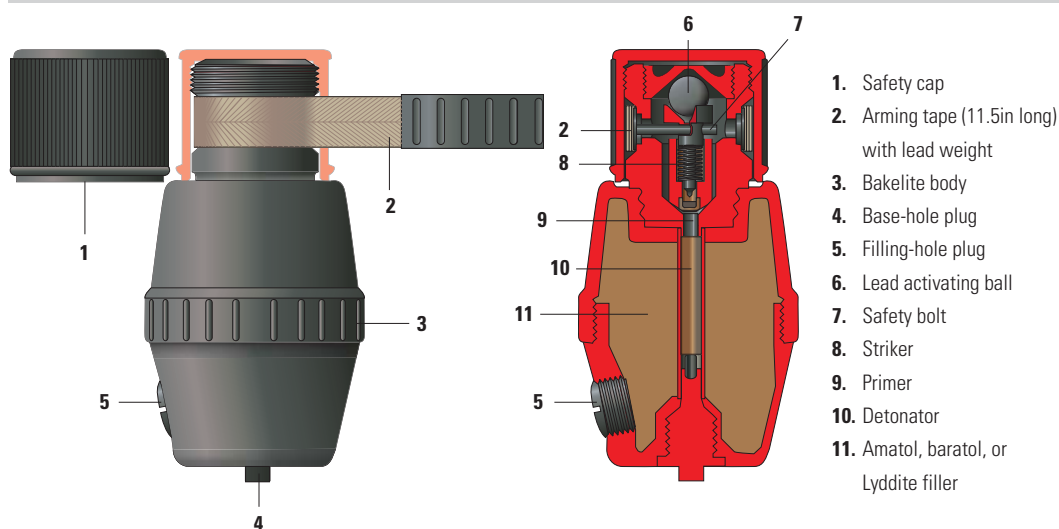
French hand grenades

France began World War I with one official grenade: the **M1847**, a pig-iron spherical grenade, 81mm (3.19in) in diameter, with an “undated” wooden-bodied friction igniter employing black powder. The M1847 weighed 1.2kg (2.65lb) and had a 5-second delay. The **M1914** had a somewhat improved metal friction igniter and weighed 1kg (2.20lb). The Munitions Service produced various crude, field-expedient grenades, which proved largely unsafe. Adopted in May 1915, the **P1** (percutante n°1, or “impactful no. 1”) was known as the *poire grenade* (“pear grenade”). Weighing 550g (1.21lb), it was one of the first grenades with a spoon-like arming lever. It had a percussion igniter and was impact-detonated, if it landed base first on sufficiently hard ground. The mud of no man’s land often caused failure to detonate or dampened the blast. Premature detonations were common and even though it was one of the few grenades with internal segmentations, its break-up was poor. The P1 was invented by a Monsieur Billant, who developed the more successful **M1916B** percussion fuse that was to set the standard for grenade fuses.

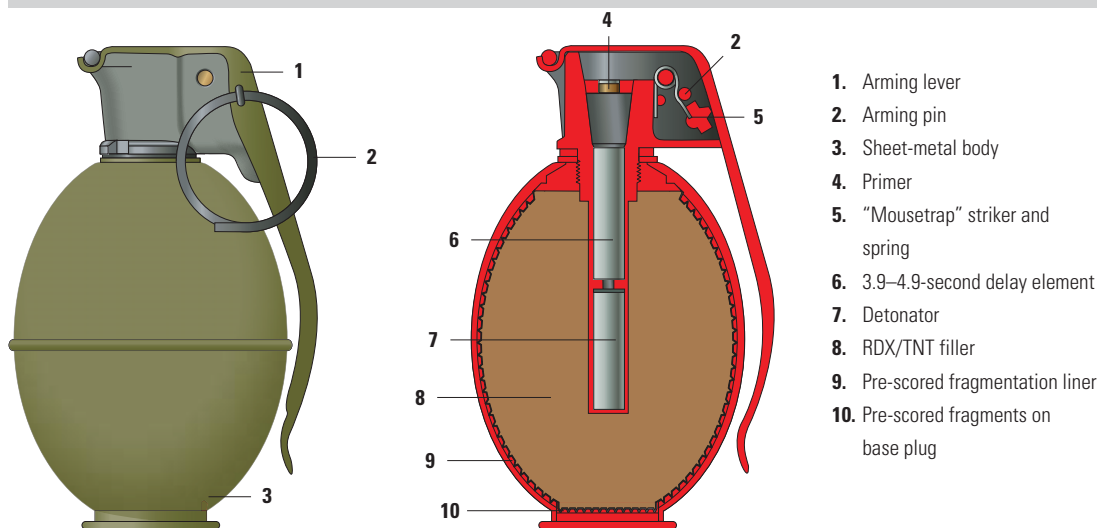
A more effective and safer grenade was also introduced in May 1915, the **F1** (fusante n°1 – “fusing no. 1” – or grenade à main défensive F1 – “F1 defensive hand grenade”). It is difficult to say if it was fielded before or after the British Mills Bomb (see above). Several different types of fuses were used on the F1. The *bouchon allumeur à mèche* (plug wick igniter) was fitted on the earliest F1s. The M1915 percussion plug igniter (bouchon

BRITISH HAND GRENADES SINCE 1939

British No. 69 Mk I offensive hand grenade



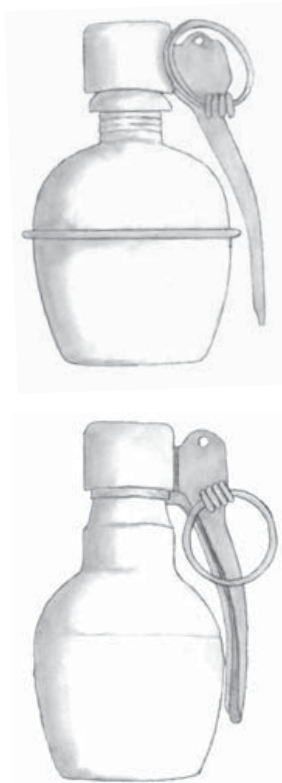
L2A2 antipersonnel hand grenade



Adopted in December 1940 and remaining in service until 1947, the **No. 69 Mk I** offensive grenade – "Bakelite" or "assault grenade" – generated virtually no fragmentation because of its frangible Bakelite body. It caused little material damage, relying on blast and flash to injure and unnerve the enemy. Its No. 247 all-ways impact fuse was on the top with the detonator in the bottom. The 13.5oz grenade was filled with 3.25oz of amatol, baratol, or Lyddite (picric acid). It was also made in Australia, of dark reddish-brown Bakelite. The No. 69 was also used as a training grenade; for this purpose it was thrown only behind advancing troops to simulate artillery and was to be detonated no closer than 30yd. Its use during night

exercises was restricted because of its blinding flash and the danger of throwing it near unseen soldiers. This practice was halted when casualties resulted from the fuse's lead ball.

The **L2A1** antipersonnel grenade, shown here with the L25A6 fuse, was essentially a 1964 copy of the US M26A1 (see below) with differences in the fuse – the most noticeable being a 3.6–5.5-second delay, rather than the M26A1's 4–5 seconds. The **L2A2** involved manufacturing improvements. A product-improved version, the Royal Ordnance **RO 01A1**, has replaced these; it is bronze green with yellow markings.



OF37 offensive (above) and DF37 defensive (below) hand grenades with M1935BG lever-delay fuses. These pre-World War II grenades are still in use today with modernized fuses. They were employed in Indochina/Vietnam, Algeria, and later conflicts, with wide use throughout Africa. The bodies of World War II-era OF37 and DF37 grenades had a yellow upper half, while the color of the lower half was dependent upon the explosive: yellow (TNT); green (Cheddite or Lyddite); or brown-red (Schneiderite, amatol, or ammonium nitrate/xylite). (Author)

allumeur à percussion M1915) consisted of a percussion igniter held in a small cardboard tube; it had to be struck on a hard surface to ignite the delay fuse. This was protected by a removable, sealed cardboard tube, 60mm (2.36in) long and 12mm (0.47in) in diameter. It was far from waterproof and the long fragile “protective” tube and the percussion igniter tube were easily damaged. A somewhat improved M1916 percussion plug igniter (bouchon allumeur à percussion M1916) consisted of a shorter brass tube containing the percussion igniter with a shorter brass protective cap. This was less susceptible to damage and more resistant to moisture. It still experienced reliability problems and was not sufficiently waterproof. In 1916 Monsieur Billant developed the M1916B automatic plug igniter (bouchon allumeur automatique M1916B). All fuse delays were 5–7 seconds. As with other segmented-body fragmentation grenades, the F1 did not break up according to the segments, nor did it shatter into a great many smaller fragments. It was not uncommon for it to break up into only ten or so fragments. Casualty radius was 20m (22yd), with a 75m (82yd) danger radius. During World War I the F1 was painted blue-gray. From the early 1930s it was painted reddish-brown.

While the F1’s performance was far from ideal, it proved popular and was one of the most widely used French grenades in World War I. After the war all other fragmentation grenades were retired and improved explosive fillers introduced, causing more effective fragmentation. While replaced by the much-improved Mle 37 grenades (see below), F1s were still in use at the beginning of World War II. They continued to be used by the Vichy French in Metropolitan France and North Africa and of course in overseas colonies including Indochina. The Japanese used some in Southeast Asia and German troops employed them in France. France sold some to Finland during the 1939–40 Winter War. They were provided to White Russian forces during the 1917–22 Civil War and were also used by Poland during the 1920s border clashes with the Soviet Union. The F1 served as a model for other countries’ grenades, influencing the Polish wz. 33, US Mk I and Mk II, and Soviet F-1, from which other F1 spin-offs were derived (see below).

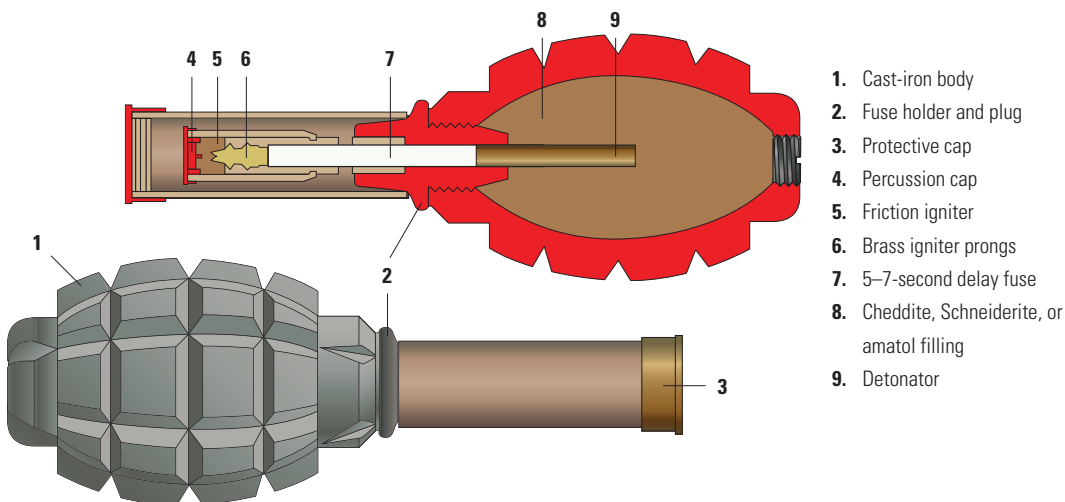
The French adopted two new grenades in 1937, the **OF37 offensive** and **DF37 defensive** hand grenades (Grenade à main offensive OF M1937 and Grenade à main defensive DF M1937). Both had oval bodies with flat bottoms. They have used the M1931BY or M1935BG 5-second lever-delay fuses. The OF37 blast grenade has a thin aluminum body with a circumference rim allowing night identification. The DF37 fragmentation grenade has a cast-iron body. Height is 95–105mm (3.74–4.13in) depending on fuse; the OF37 is 60mm (2.36in) in diameter and the DF37, 55mm (2.17in). Several different types of filler were used, but post-World War II grenades have TNT. Newer grenades have OD bodies, with those manufactured by Ruggieri using the M F3 fuse similar to earlier models. Those made by Alsetex use the M F5A pyrotechnic delay fuse.

German hand grenades

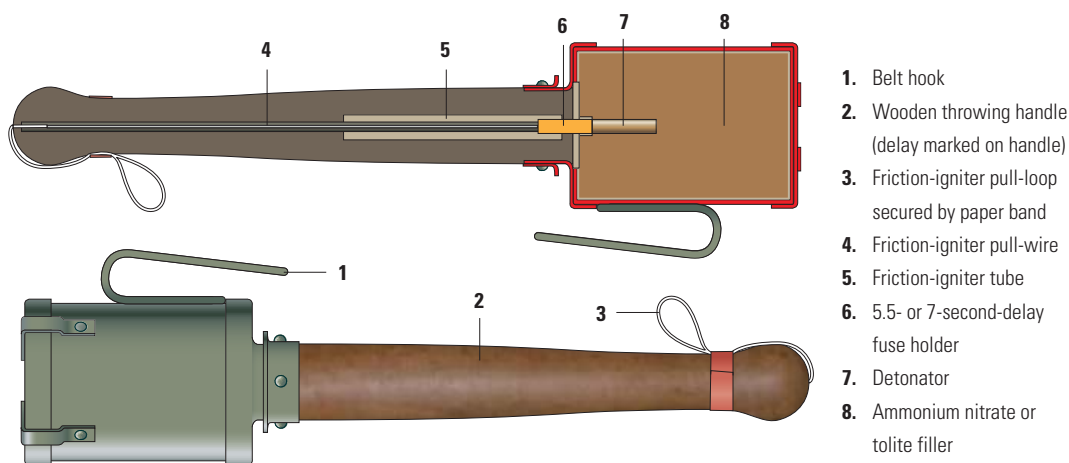
The beginning of World War I found the Germans somewhat better equipped with grenades than their enemies. Even so, “trench-made” –

FRENCH AND GERMAN HAND GRENADES OF WORLD WAR I

French grenade à main défensive F1



German M1915 Stielhandgranate



The French **F1**, shown here with the M1915 fuse, soon became known as *la citron* ("lemon") due to its shape or the *ananas* ("pineapple"), because of its deep segmentations, and *grenades quadrillées* ("square-patterned grenades") owing to the segmentations. The F1 – and its fuse, very advanced for the time – would have a great deal of influence on grenade design in spite of its marginally effective fragmentation. The cast-iron body was 90mm (3.54in) long without a fuse and 55mm (2.17in) in diameter. Weight was approximately 710g (1.57lb) depending on the type of fuse. In the top was the fuse well with a filler hole in the bottom. At first the F1 grenades were filled with Cheddite and later

Schneiderite, amatol, or nitrate-xylyte – ammonium nitrate-based explosives.

The German **Stielhandgranaten** of World War I all had thin-walled steel cylindrical heads with a belt clip; they were typically 105–120mm (4.13–4.72in) long and 72mm (2.83in) in diameter on a wooden handle 240–260mm (9.45–10.24in) long. They weighed about 820g (1.81lb) with a 270g (9.52oz) filler, either ammonium nitrate or – from 1916 – more powerful tolite. Most delay fuses were 5.5 seconds, but some had 7-second delays. Delay time was marked on the side of the head.



The *Diskusgranate* had a diameter of 105mm (4.13in) and a height of 30mm (1.18in). Requests from the front asked for a grenade that could be thrown farther than the ball grenade and was impact-detonated. The resultant grenade was a convex disc containing six tubes arranged in a star-like pattern. These contained a complex arrangement of firing pins, sliding tubes, and a detonator. When thrown, a spin was imparted on the grenade, as with throwing an actual discus. They could reach up to 50m (55yd). Centrifugal force slid the internal tubes to uncover four firing pins. Upon impact, one or more of the firing pins struck the primers in the center and fired the detonator. It was armed by pulling an arming ring on the edge. (© IWM MUN 3221)

Behelfs ('improvised') – grenades were necessary to supplement issue grenades. These were mainly made from ration tins or were of the "hairbrush" type. The first issue grenade was the **Kugelhandgranate 13** ("ball hand grenade 1913"), a deeply segmented spherical grenade with a friction igniter. Other than the segmentations (for a better grip), it was little different from 19th-century grenades. An improved fuse and simplified casting requirements resulted in the **Kugelhandgranate 15**. Both were heavy, at 1kg (2.20lb), and packed with 45g (1.59oz) of explosive. Complaints of 15m (16yd) throwing ranges eventually led to lighter grenades. The **Eierhandgranate 17** ("egg hand grenade 1917") appeared in early 1917. 60mm (2.36in) long and 46mm (1.81in) in diameter, it had a smooth cast-iron body and friction igniter. It weighed only 318g (0.70lb) with a 32g (1.13oz) filler. A new type was issued in late 1917, featuring an improved fuse and a segmented band around the circumference to provide a firmer grip.

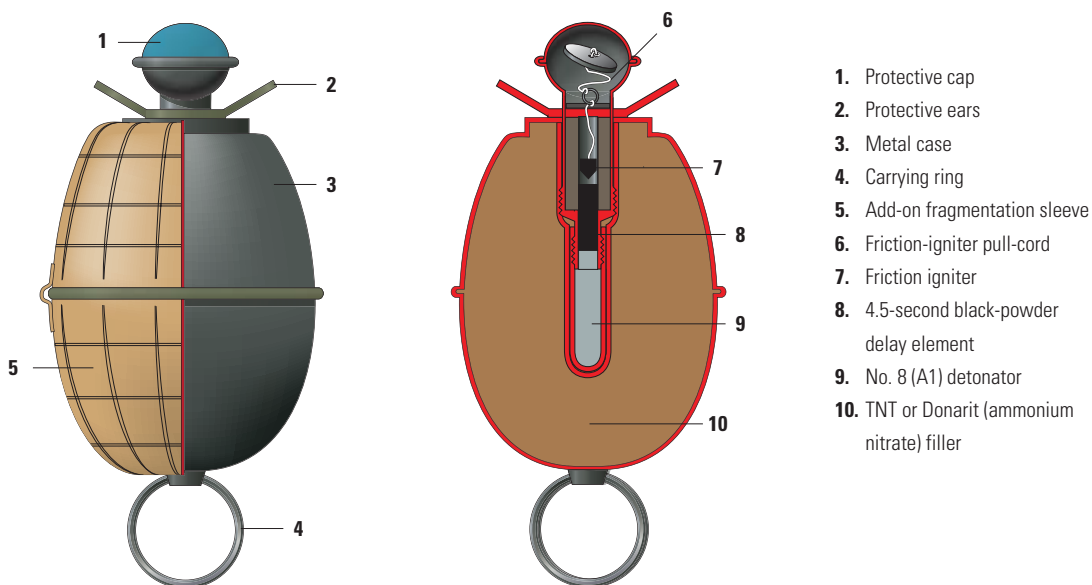
The improvised "hairbrush" grenades were thought to achieve greater range and accuracy. This led to a series of *Stielhandgranaten* ("stick hand grenades"), with the first appearing in 1915. The main differences between models were improved, more reliable fuses and better waterproofing. Most had friction pull-initiated fuses with a detonator in the base of the head where the handle fitted. The handles were bored with a pull cord. In 1916, versions were adopted with a threaded cap on the handle's end to protect the pull cord and prevent water from entering the pull-cord hole. Two new types appeared in 1915, both percussion-impact grenades, and a further-improved model in 1916. These were armed by pulling an arming ring on the handle and throwing them so they would impact head-first. To improve safety, a "spoon" or lever was fitted to the handle. The ring was pulled and when the grenade was thrown the spoon flew off, arming the grenade. As with most impact-detonated grenades, they were none too popular and often failed to detonate in mud or landed on their side.

One of the more unusual types of grenade during World War I was the **Diskushandgranate 15** ("discus hand grenade 1915"). This 420g (14.82oz) grenade was considered an offensive grenade. It was used as a booby trap by pulling the pin and balancing it, for example, on the top of a door. When the grenade fell it detonated on impact. It was small enough, 105mm across, 30mm thick, to push through a tank's vision slits. Weighing 360g (12.70oz), the less common and smaller 1915 *Eierhandgranate* ("egg hand grenade") had thicker walls with internal segmentations to improve fragmentation. Besides standard German antipersonnel grenades, dozens of expedient grenades were fielded during World War I's final months in a wide variety of materials including concrete and wood.

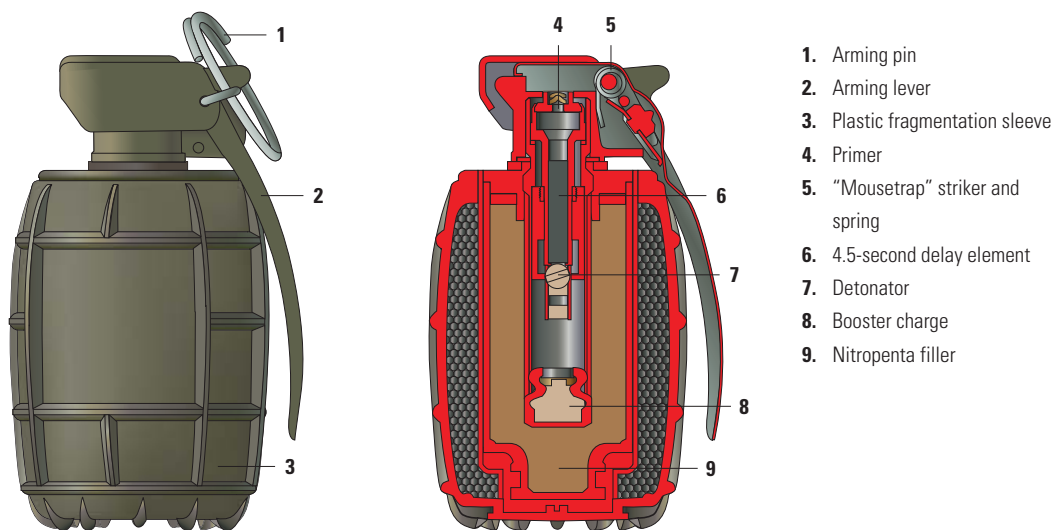
The **Stg 24** (*Stielhandgranate 24*, or "stick hand grenade 1924") was the commonest German grenade during World War II and derived from various World War I models of "potato-mashers" (*Kartoffelstampfer*). It consisted of a field-gray steel head with a hollow wooden handle containing the fuse and detonator. The pull cord was inside the handle protected by a screw cap. The handle's end cap was unscrewed and a porcelain bead pulled to initiate the 4.5-second delay train. Slip-on fragmentation sleeves were introduced in 1942. The 14in-long grenade

GERMAN HAND GRENADES SINCE 1939

Eihgr 39 nA



DM51 Spreng/Splitterhandgranate



The World War II-era **Eihgr 39 nA** included protective steel "ears" on the fuse and the carrying ring on the bottom, both added in early 1942. A two-piece fragmentation sleeve was fielded from September 1944, but saw little use. The egg grenade contained either 112g (3.95oz) of TNT or 225g (7.94oz) of Donarit (commercial ammonium nitrate). To arm it, the blue fuse cap was unscrewed and pulled to start the 4.5-second delay. For use as a booby trap, 1-second delay igniters with a red cap were provided with this grenade; when Allied soldiers

attempted to use these, they detonated when the cord was pulled.

Developed by Diehl Defense, the **DM51** is a dual-purpose grenade consisting of a small plastic cylinder containing 60g (2.12oz) of Nitropenta with a DM82A1 lever-release fuse (3–5-second delay) as a blast grenade. It has a safety clip, and is issued with a double-walled oval body with flat ends that the blast grenade slips into, secured by a twist-lock. The ribbed plastic body contains 6,500 steel ball bearings. It is 107mm (4.21in) high and 57mm (2.24in) in diameter.



The Stg 24 (Stielhandgranate 24 mit Brennzünder 24, or “stick hand grenade 1924 with igniter fuse 1924”) was Nazi Germany’s most widely used grenade. It remained in use with the forces of some European countries into the 1950s. This is a cutaway instructional grenade. The “potato-masher” (*Kartoffelstampfer*) or “doorknocker” (*Türklopper*) became an iconic symbol of the German infantry. (Public Domain)

contained a 6oz TNT or black-powder (substitute) charge. The **NbHgr 39** (Nebelhandgranat 39, or “smoke hand grenade 1939”) was similar to the Stg 24, but generated white smoke.

A widely used grenade was the **Eihgr 39** (Eihandgranaten 39, or “egg hand grenade 1939”). This 9oz blast grenade was approved in April 1940. It was lighter, and faster and quicker to manufacture, than the stick grenade; more could be carried, and they could be thrown farther. There were also little-used 7.5-second delay fuses with a yellow cap and a 10-second with a white cap. The **Eihgr 39 nA** (Eihandgranaten 39 neuer Art, or “egg hand grenade 1939 new type”) was also widely used. Besides smoke screening, the Germans employed smoke grenades to blind tanks and allow close-in infantry attacks. The **Stg 43** (Stielhandgranate 43) was a Stg 24 substitute with the Eihgr 39’s fuse fitted atop the head and a solid-wood handle.

German-designed grenades reappeared in the West German armed forces in the 1970s. The **DM51 Spreng/Splitterhandgranate** (“blast/fragmentation hand grenade”) was adopted in 1978, replacing the **DM41 Splitterhandgranate**, the US M26A1. It is supplemented by the **DM61** fragmentation hand grenade, also a Diehl design, with a double-walled pear-shaped plastic body containing 6,000 ball bearings, each 2mm (0.08in) in diameter. 103mm (4.06in) high and 57mm (2.25in) in diameter, it contains 65g (2.29oz) of Nitropenta and a DM82A1 fuse, and provides 5 percent better fragmentation uniformity than the DM51. It is also used by Norway.

Italian hand grenades

The **Mod. 23 petardo offensive** (“offensive petard”) was a 400g (14.11oz) blast grenade 120mm (4.72in) long and 80mm (3.15in) in diameter. It was activated by a percussion fuse and had an all-ways impact fuse. The “P.O.” was used by Ecuador during the Zarumilla–Marazñón Border War with Peru in July 1941. It may have seen limited use in the Spanish Civil War and early in World War II. The **MCS hand grenade** had an all-ways impact fuse and was adopted in the late 1920s. It had a cylindrical body with truncated cone-shaped ends. Its two-piece body screwed together at the mid-section with a separately contained explosive chamber. It was armed by pulling a ring that withdrew an arming strip, blocking the firing pin, and holding down a large safety ring that encircled the upper part of the body. When it was thrown, the safety ring fell off and the fuse was armed.

The “**S**” hand grenade was a small, offensive, blast grenade and was the first Italian grenade with an all-ways impact detonator. Its two-piece, egg-shaped body screwed together at the mid-section. Introduced in the late 1920s, it was withdrawn from use during the Spanish Civil War as the sensitivity of the fuse made it dangerous to the thrower. A safety pin was pulled while holding down a safety band that encircled the grenade. The band fell free when thrown and the impact fuse was immediately armed, making it extremely hazardous if dropped by the grenadier. The meaning of the “S” is unknown.

The **SRCM Mod. 31** hand grenade was similar to the above MCS grenade and intended as an improvement. It was of the same shape, but

with small projections on both ends. Rather than a ring on the arming strip it had a pull tab, which was used on most subsequent Italian grenades. Besides the safety ring it also had a safety cover attached to the ring, making it easier to retain before throwing. The inner explosive chamber had a thin, segmented fragmentation sleeve. Short, free-floating metal tubes on each end of the inner explosive chamber fit into the outer body's end projections and held the charge in place. Upon impact, the explosive chamber was knocked loose, regardless of the angle of impact, to release the spring-loaded firing pin and detonate the grenade. The Czechoslovak RG-34 hand grenade was copied from the SRCM Mod. 31.

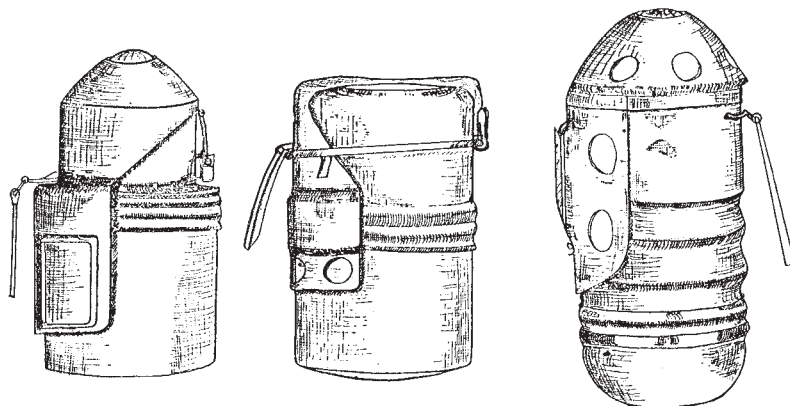
From the mid-1930s Italy made extensive use of three different Mod. 35 hand grenades (bomba a mano mod. 35) of vaguely similar design, but made by three different manufacturers. The manufacturers' initials were included in their designations to differentiate them. The reason three manufacturers' variants were used was to allow rapid stocking to support the government's aggressive aims. The **Breda Mod. 35** hand grenade (Bomba a mano Breda modello 35) was not as effective as other Mod. 35s owing to its light blast, but the Breda model was one of the most widely used of the three because of Breda Meccanica Bresciana's production capacity. The body had five lateral, raised corrugations and both ends were shaped as a truncated cone, with a hemispherical safety cover. When the safety strip was pulled out and the grenade thrown, the safety cover fell free, pulling a brass strip which was wound around the head twice. This strip was attached to the safety device and was pulled out to arm the fuse when the cap and strip fell away. The heavy head held the firing pin, which detonated the grenade upon impact. With red body and black safety cover, the Breda Mod. 35 was 96mm (3.78in) long and 58mm (2.28in) in diameter.

The **OTO Mod. 35** hand grenade (Bomba a mano OTO (Oto Melara SpA La Apenzia) modello 35) was the smallest Mod. 35 and considered the most reliable, but produced few lethal fragments and a light blast. It had a cylindrical body containing a separate explosive chamber and a smaller-diameter upper section shaped as a truncated cone. When the safety pin was pulled the safety cover was freed. The cover fell free when the grenade was thrown, pulling out the safety strip. A metal ball filled with lead shot was contained in the upper section. Upon impact the ball was driven into the firing pin to detonate. The lower half of the body was



100mm (3.94in) long, 65mm (2.56in) in diameter, and weighing 630g (1.39lb), the Besozzi grenade was provided to French forces in early 1915 and later produced in France under license. It appeared similar to the Mills Bomb, but had an unsegmented band around the body, which consisted of two halves that screwed together and provided poor fragmentation. A friction match-head was molded onto the 5-second time fuse inserted in the top. (© IWM MUN 3223)

Italian impact-detonated "Red Devils": (left to right) The OTO Mod. 35 was considered the most reliable; the SRCM Mod. 35 had a heavier explosive charge and fragmentation liner; and the Breda Mod. 35 was the most widely used, but least effective of the "Red Devils." Each was operated by pulling a rubber arming tab (allowing it to be pulled by the teeth), which withdrew a safety strip, and allowed the safety cover to fall free when thrown. Upon impact, some form of firing device drove the firing pin into the detonator to detonate the TNT. They were only moderately effective owing to their stamped-aluminum bodies providing minimal fragmentation. Casualty radius was 4m (4.5yd) for all makes except the SRCM, with 8–14m (9–15yd). Mixed batches of makes were habitually issued to units. (US Army)



To throw the US Mk I grenade, the thumb was placed against the lever and the pin pulled. The lever was pivoted to one side when the grenade left the hand. This allowed the fuse cover to fly off, releasing the spring-loaded striker to ignite the delay train. It was more problematic with the underhand throw, as it was difficult to pivot the lever with the thumb. The pin was pulled and the lever rotated, allowing the cover to fall off – sometimes it had to be shaken off. It could arm while still in the hand. Either way, it had to be gripped correctly, with the thumb laid precisely in position and the thrower coordinated enough to thumb the lever properly when thrown. The Mk I's body was similar to the French F1's, but a higher-grade malleable iron was used. It was slightly more powerful, with 2oz of TNT or 50/50 amatol and nitro-starch. Body production went smoothly, but the chief concern was the "bouchon" fuse, which was also rather expensive. The Mk I 5-second delay fuse had a separate top cover on the fuse housing and a pivoting arming lever that was fixed to a downward-angled projection on the fuse housing's bottom. The lever was creased down the center to provide a U-shaped bar – not the later thin, flat lever. It was fixed to the projection by a screw on which it pivoted. (Tom Laemlein/Armor Plate Press)



red while the upper half was unpainted aluminum; it had a black safety cover and was 86mm (3.39in) long and 53mm (2.09in) in diameter.

The **SRCM Mod. 35** hand grenade (Bomba a mano S.R.C.M. (Società Romana Costruzioni Meccaniche) modello 35) was the only Mod. 35 with a fragmentation liner and had a heavier explosive charge, but its fragmentation effect was limited. It contained an explosive chamber with a detonator separated from the fixed firing pin by a spring. The explosive chamber was wrapped with twisted wire for fragmentation. When it was thrown, the safety cap fell away, pulling a small chain that pulled out the safety strip. Upon impact the explosive chamber's detonator was driven into the firing pin. Commonwealth troops removed the fuse assembly and explosive charge and modified the grenade body into a dugout oil lamp. Its production continued until 2012. It was 80mm (3.15in) long and 64mm (2.52in) in diameter, and was initially distinguished by its red body and safety cover in unpainted aluminum.

After World War II, the grenade had an OD body but retained the unpainted aluminum safety cover. To replace the SRCM Mod. 35, the **OD-82** (*Offensiva-Difensiva*) was adopted in 1982. Its body was 59mm (2.32in) in diameter and 83mm (3.27in) high. The 285g (10.05oz) grenade had a 112g (3.95oz) Comp B charge, making it effective as both a blast and fragmentation grenade. The original 4-second fuse occasionally detonated early and an improved fuse was adopted in the mid-2000s. It has a large arming lever and a pull-type arming tab. Early grenades were colored gray, while late grenades are olive drab, both with yellow bands.

US hand grenades

Since World War I the United States has essentially used three models of fragmentation grenades, all of which have been employed by numerous other countries. The United States adopted a cylindrical hand grenade with a throwing sling in 1911. It never saw combat. Within days of the US declaration of war on Germany (April 2, 1917) the Ordnance Department's Trench Warfare Section was established to oversee grenade development and production. The Trench Warfare Section, after examining French and British grenades, was determined to develop the simplest, safest, and most effective grenade. The design of the **Mk I defensive hand grenade** was completed in August 1917 and mass production commenced soon after. In the effort to design the safest-possible grenade, however, the Mk I proved overly complicated. It was too much to expect of a soldier under the stress of combat and possibly with cold hands in rain and mud to manipulate it correctly. Some were thrown without the lever having been turned. This prevented its detonation and allowed the enemy to return it. Over 23 million grenades would be produced by the war's end, but on May 9, 1918, the American Expeditionary Forces (AEF) sent a cablegram rejecting the Mk I as too complicated and unsafe.

The Mk I's successor, the **Mk II "pineapple" defensive grenade**, would see almost 50 years' service. Plans for the Mk II defensive grenade were ready on August 1, 1918 and new machinery had been installed. Existing Mk I bodies could be used, but new fuses had to be produced. The Mk II



A US Marine Corps ordnance technician spray-paints formerly yellow Mk II fragmentation grenades OD in 1943. It was discovered on Guadalcanal in late 1942 that the yellow color helped the Japanese find grenades at night and they threw them back or took cover. Yellow was also conspicuous when grenades were hung on web gear. Prior to 1943, all HE munitions were yellow and then repainted OD. In 1943 they began to be painted OD instead. The Office of Strategic Services, a precursor of the later Central Intelligence Agency, requisitioned Mk IIs with zero-delay fuses for use as booby traps with tripwire and tape in each container. The container and arming handle were secured with red tape warning of immediate detonation when the handle was released. A red metal tag on the pull ring offered the same warning. Some of these were used in Korea by UN partisan forces. More Mk IIs and Mk IIA1s were produced than any other hand grenade in World War II. They were supplied to the Free French, Nationalist Chinese, and various partisan forces. The Mk II body was used for the warhead of the 1942 M17 fragmentation rifle grenades. Two bodies fitted in tandem were tested as an antipersonnel rocket for the 2.36in bazooka. (Tom Laemlein/Armor Plate Press)

“bouchon” fuse was totally redesigned, being more similar to the French M1916B. The fuse cover and level were now one piece and the lever pivot was omitted. Some 44 million were ordered and well over 21 million completed by the war’s end. Few reached France. Refinements were made after the war and the new **Mk II high-explosive hand grenade** was adopted in 1920. The M5 fuse was easier to manufacture and improved for reliability and safety. Mk II HE grenades were still in use at the beginning of World War II. From 1920 Mk II bodies were painted yellow as a cautionary warning and to help locate duds during training. 4.5in long and 2.3in in diameter, the Mk II was normally filled with 1.85oz TNT, but owing to shortages, some early examples were filled with 2.33oz Trojan explosive, while others were filled with 1.85oz of amatol 50/50 or more sensitive Grenite. In 1930, minor changes were made to the Mk II to accommodate refinements in production techniques, and “HE” was dropped from the designation. Its color, characteristic shape, and segmented body led to its nickname, the “pineapple.” It was just as widely known simply as the “frag.” Mk IIs were also filled with 0.74oz EC blank fire powder, which was used in blank ammunition and designed to create high pressure even unconfined.



Ethiopian soldiers of the 3rd Kagnew (Conquerors) Battalion attached to the 32nd US Infantry Regiment, 7th Infantry Division in Korea. Each carries a newly issued M26 fragmentation grenade suspended on his M1951 body armor vest, which is fitted with web grenade suspension loops on the left chest. Owing to its oval shape the M26 became known as the “lemon grenade.” OD with yellow markings, this 16oz grenade used the M204A1 fuse as on late examples of the Mk 2A1. It was 3.9in long with a diameter of 2.5in. (US Army)

The **Mk IIA1** hand grenade,¹ introduced in 1942, was filled with EC blank fire powder. It had no bottom filler hole. In 1944, 1.85oz of TNT replaced the EC powder and M204-series silent-type fuses were fitted. The earlier fuses made a faint pop when ignited and smoked to alert the enemy. The Mk II and Mk IIA1 both weighed 21oz (slight variations depending on the filler) with an overall length of 4.5in (3.5in for the body) and a diameter of 2.3in. On April 2, 1945, the Mk II and Mk IIA1 were redesignated the Mk 2 and Mk 2A1, respectively. They remained in use during the Korean War, including with UN forces, and on into Vietnam. The Mk 2A1 was copied by the Netherlands after World War II and copies were produced by Chile and Taiwan into the 1990s. The flaws of the Mk 2 were long recognized – poor and irregular fragmentation and less blast and fragmentation from the ends, resulting in an inadequate casualty radius. The US Army tested a small number of improved grenades during the war. Reasoning that any red-blooded American boy could throw a baseball with some accuracy, baseball-sized grenades were developed. The 5.5oz T12 and 11.9oz T13 “Beano” fragmentation grenades were impact-detonated. Field testing resulted in accidents and troops rejected them.

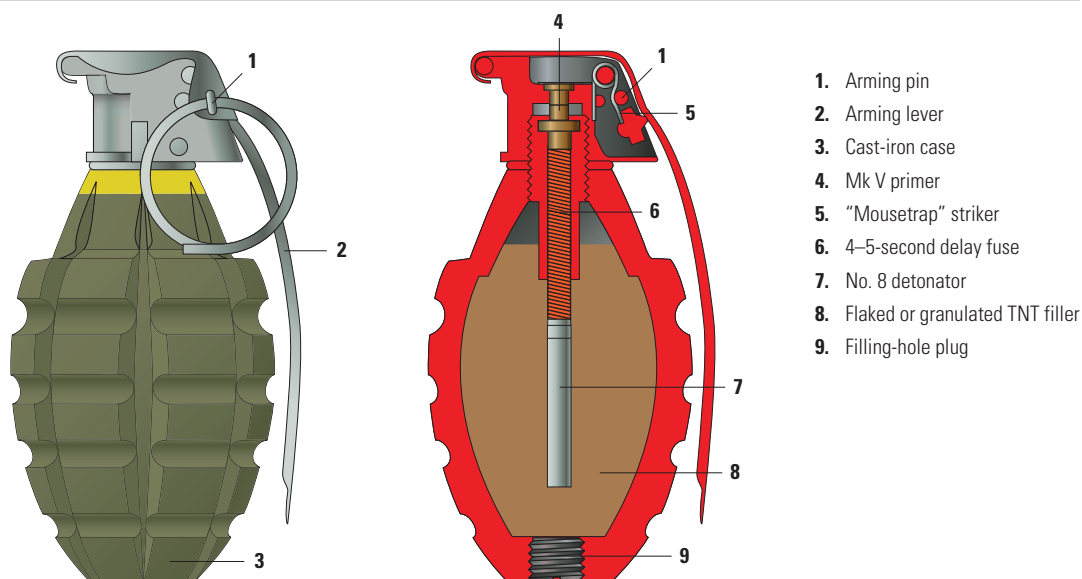
Development of the **M26** hand grenade began after World War II. To increase lethal fragmentation and provide an evenly dispersed fragmentation pattern, the T38 was developed. It had a sheet-steel, oval body lined with coiled steel wire. The 0.13in-diameter wire was scored every 0.20in ensuring effective uniform fragmentation into 1,150 fragments – each weighing 0.13 grains – to inflict fatal or disabling wounds within 15m (16yd). Killing radius was 5m (5.5yd). The filler hole cap on the bottom contained a layer of pre-scored fragments. The T38 was standardized as the M26 in 1952 and was first used in small numbers in Korea during the spring of 1953. A further improvement was the **M26A1**, with 0.13in-square wire scored every 0.13in; this was used in all subsequent models. The M26A1 was filled with 5.5oz of Comp B and a 0.25oz tetryl booster.

The **M26A2** was an impact-detonated grenade fitted with an M217 impact fuse. This fuse was larger in diameter than the M204. When thrown, the lever flew off and the striker ignited a primer which activated a thermal power source after 1–2 seconds. It would detonate upon impact after that. If it did not impact or the impact mechanism failed, the thermal source continued to burn and would detonate after 4 seconds. If it still failed to detonate, the power source continued to burn for 30 seconds and then became inactive. The lever on early grenades was red with or without “IMPACT” in black. Later grenades had only “IMPACT” embossed on their levers. The troops rejected impact-detonated grenades, however. If after arming they were dropped or struck vegetation they caused friendly casualties. To confuse matters, there was also a non-impact-detonated version of the M26A2 grenade with an M204A1 delay (non-impact) fuse and the small fuse well.

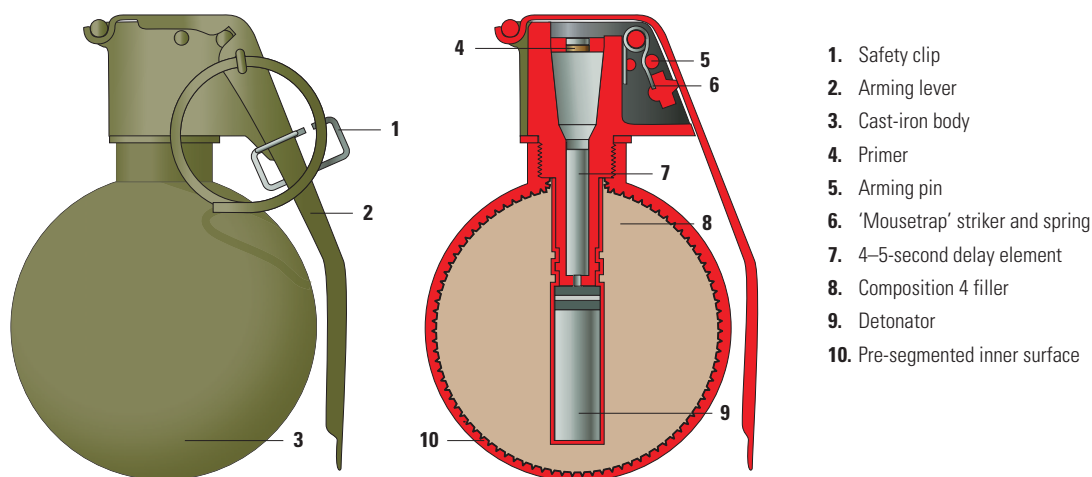
1 Some references state the Mk IIA1 designation was not official and only used by collectors to identify later Mk IIs without filler holes. The Mk IIA1 is identified as such in Army technical manuals.

US HAND GRENADES

Mk II defensive hand grenade



US M67 fragmentation hand grenade



The **Mk II** used several models of fuse over time. They were of the same basic "mousetrap" design. The differences were modifications for improved manufacture, safety, and reliability. All were 4–5-second delay except the M6A4C (4 seconds) and the M10A3 (4.3–5.5 seconds). The M10A1 of 1942 was withdrawn, as the primer flash sometimes bypassed the fuse, causing instantaneous detonation. The M204 series of 1944 had a silent-igniting, non-sparking, non-smoking primer and delay element. The M204A1 was introduced in 1945. Because there were so many grenades in the supply pipeline with older fuses, few of the improved fuses saw combat.

Since 2000, Canada has produced the **M67** as the C13 to replace the US M26 series. It suffered high dud rates – 20 in 1,000 as opposed to the US one in 1,000. A licensed copy of the M67 is produced in Switzerland as the HG85 – not to be confused with the Austrian Arges HG85. License-produced M67s have slightly different fuses and safety clips. The M67 and HG85 are used by other European, Middle East, and Far East countries, and most Central American countries. Korea uses the M67 and the domestically produced K400 with a slightly different body shape. It is also popular with Mexican drug cartels and Central American insurgents.

In the mid-1960s a minor modification was added to M26-series grenades to improve safety. Grenades were often hung on suspenders and belts. Grenade rings could catch on vegetation and a pin could be pulled. There were occasional instances of suicidal prisoners lunging at captors, pulling a grenade ring on the soldier, and hugging him to prevent him throwing the armed grenade clear. A wire safety clip, known as the “jungle clip” as it was spawned by events in Vietnam, was fitted to new-production grenades. The advent of the “jungle clip” led to a number of redesignations. The **M56** was formally an M26A2 with an M215 fuse – a larger-diameter pyrotechnic delay fuse rather than the usual time fuse – and the safety clip. The M56 was later declared obsolete. The impact-detonated version of the M26A2 was redesignated the **M57** with the safety clip added. With the safety clip added, the M26A1 was designated the **M61**. The M26-series grenades were effective, but offered an inconsistent casualty radius and were heavy, at 1lb. The M26 series began to be replaced in 1968 and production ceased, but it continued in US use into the 1970s.

Development of the **M33** hand grenade began in the late 1950s, resulting in a 2.5in-diameter spherical grenade 3.2in high with fuse. It weighed 14oz – 2oz lighter than the M26 – and contained 6.5oz of Comp B, 1oz more than the M26. The 0.13in-thick steel sphere was internally pimpled with a 0.19in segmentation pattern. It breaks up into irregular shaped pieces of 2–12 or more “pimples.” Its lethal radius is 5m (5.5yd), but can cause casualties up to 15m (16yd), dispersing stray fragments up to 230m (250yd). The fragmentation radius was relatively consistent regardless of how the grenade was oriented after landing. The M213 fuse had a 4–5-second delay similar to the M204 series, but a larger detonator negating the need for a booster charge.

A more widely used version, differing from the M33 only by the addition of a safety clip, was the **M67 “baseball grenade.”** 3.53in long and 2.52in in diameter, it was not fielded until 1968 in Vietnam and while the M26A1/M61 remained in use, by 1969/70, the M67 was more widely employed. A second model was the **M33A1**, an impact-detonated grenade with an M217 fuse. “IMPACT” was embossed on the lever. It was designated the **M59** with the safety clip. The **M68** was the same with slight specification changes. Like the M26A2/M57, it was disliked by the troops and fell from use. The M67 remained the standard frag grenade after Vietnam and is still in use. Production ceased in the late 1990s and M67 war stocks were projected to be expended by 2001. With the US involvement in Afghanistan and Iraq, production was resumed, but a new grenade was considered. The Belgian MECAR FRAG-C M72 controlled-fragmentation grenade plus the German Diehl and Austrian Arges lightweight grenades – also controlled fragmentation – were considered. It was determined these grenades were not so superior to the M67 to warrant further testing and converting production lines. Additionally, numerous countries were purchasing M67s from the US or license-producing them so it was becoming practically a NATO standard.

RUAG Ammotec’s HG 85 grenade. The HG 85 is used by Britain as the L109/L109A1 and the Netherlands as the Nr330 and Nr330C1/C2. Instead of the normal straight lever, the HG 85-based grenades have a spoon-shaped lever, preventing it from slipping through another grenade’s arming ring and inadvertently pulling it. The United States did not adopt this spoon-shaped lever as no similar incidents were reported. The L109 and Nr330C1/C2 have plastic safety clips. (CC-BY-SA-2.0-fr/Rama)



The smallest hand grenades

The smallest grenade ever fielded was the Dutch-made **V40** fragmentation hand grenade, produced by Nederlandse Wapen en Munitiefabriek (NWM). Called “mini-frags” or “hooch poppers,” they were issued to US MACV-SOG reconnaissance teams and SEALs in Vietnam from early 1969. The mini-frags were ideal for small reconnaissance teams needing to break contact with superior enemy forces as a large number could be carried. They could be thrown a considerable distance compared to standard grenades. No US designation was assigned, these being special procurement. Canada used the V40 from the late 1970s to 2006. It was withdrawn because the small lever could inadvertently be released when wearing gloves and the activation of the striker not felt.

The runner up is the Yugoslavian **Mod. 17** defensive hand grenade (Obrambena Bomba Rucna Mod. 17). This unusually small – for World War II – lemon-shaped grenade was 81mm (3.19in) high (with fuse) and 49mm (1.93in) in diameter.



The spherical V40 grenade was 40mm (1.57in) in diameter, smaller than a golf ball, and the arming-pin ring was almost as large in diameter as the grenade. It was 65mm (2.56in) high with fuse, and weighed 136g (4.80oz). It had 326 internal pre-scored fragments and a 4-second delay. The casualty radius was 18m (20yd). (Paul Bishop)

Russian and Soviet hand grenades

The Russians developed an all-metal stick grenade in 1914, the **RG-14** (Ruchnaya Granata-14, or “hand grenade 1914”). A retaining ring held the handle-mounted arming lever in-place. To arm it, the lever was held down and the safety ring removed. When thrown the lever flew open, releasing a spring-loaded firing pin that ignited the 3.5–5-second delay train. The detonator was inserted into the top of the head. A fragmentation sleeve was



A Russian soldier of World War I with a display of grenades beside his Japanese 6.5mm Type 38 (1905) rifle. Those on the table are French models – the segmented F1 defensive and the egg-shaped M1916 offensive grenades. He holds an RG-14, a blast stick grenade. (Nik Cornish at www.stavka.org.uk)

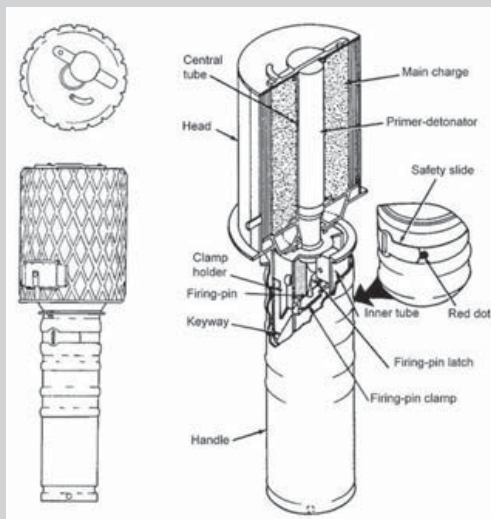
available. It was upgraded in 1930 with an improved arming system, as the RG-14/30. It saw limited use at the beginning of World War II, but was quickly replaced by other models. They were sometimes fastened together in bundles of four to attack bunkers and tank treads. The 680g (1.50lb) grenade was 236mm (9.29in) long and 46mm (1.81in) in diameter.

The Soviet Union expended massive numbers of grenades in the Great Patriotic War of 1941–45, developing numerous models during that conflict. Many remained in use by the Warsaw Pact and client states into the 1990s. Soviet and Russian grenades are olive brown with black markings. The F-1 high-explosive hand grenade (F-1 fugasnyy ruchnaya granata) was a first cousin of the French F1, discussed previously. Nicknamed the *Limonka* (lemon-like), it was copied from the French F1 grenade in the late 1920s and fielded in about 1930. It could be fitted with two types of fuse, both of which functioned in the same way despite being of a slightly different design. Early grenades were fitted with the Koveshnikov fuse, with a 3.5–4.5-second delay (the East Germans called the F-1 the *Koweschnikow*). Later grenades used the UZRG, with a 3.2–4-second delay. The Soviet F-1 was made in two variants with different dimensions. The F-1 uses the UZRG or UZRGM lever-delay fuse with a 3.2–4.2-second delay, the standard delay time for most Soviet grenades. 40mm (1.57in) tall, the tubular fuse housing contains a spring-loaded firing pin. The early version was 120mm (4.72in) long with fuse and 65mm

The most complex grenade to operate

Most grenades are simple to operate, which is a good thing when you give a hand-launched HE weapon to an infantryman. The pre-World War II Red Army of Workers and Peasants developed the RGD-33 Dyakonov hand grenade (Ruchnaya Granata Dyakonova-33). To employ the RGD-33, the safety switch on the upper end of the handle slid to the left revealing

the red “armed” marker. The telescoping outer handle was pulled back, rotated to the right, and the handle released to cock the firing mechanism; the safety switch was slid to the right, exposing the green marker, and was now on safe. The small pivoting cover on the head’s top was opened, the detonator was inserted, and the cover closed. When the user was ready to throw the grenade, the safety switch was slid left, exposing the red marker. When the grenade was thrown, the outer handle was forced back, arming the grenade to detonate in 3.2–3.8 seconds. All that and it required two hands to operate. This was a lot to ask of an under-educated peasant soldier during the stress of combat. Its complexity, along with its cost and production time, resulted in its falling from use early in the Great Patriotic War, although it remained in use with the naval infantry. At least an enemy soldier untrained on the procedure might have difficulty using captured grenades. The Germans, by the way, did use captured RGD-33s, but they had to be trained on them first.



The RGD-33, an all-metal stick grenade, had an internal scored sheet-steel liner coiled four times, and it was provided with a segmented add-on fragmentation sleeve. It was 175mm (6.89in) long and 61mm (2.40in) in diameter with the fragmentation sleeve. (US Army)

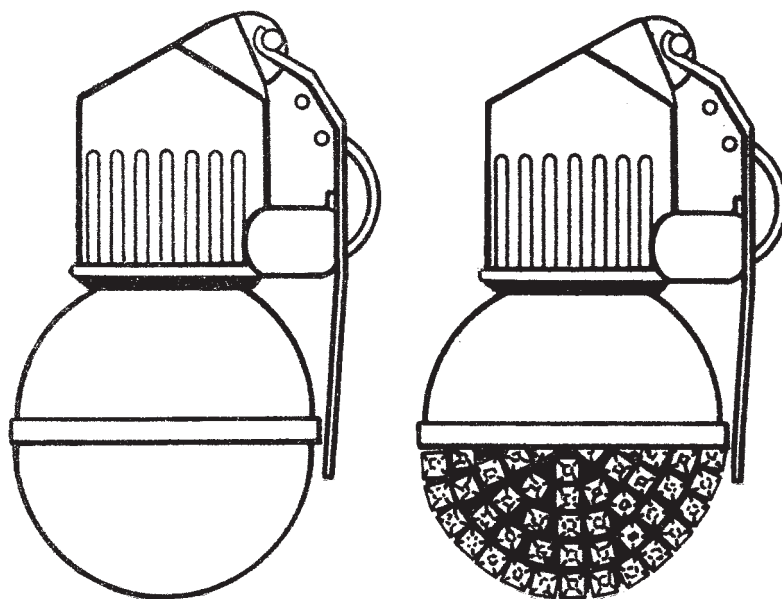
(2.56in) in diameter, weighing 700g (1.54lb) and filled with 46g (1.62oz) of TNT. The later version, issued from about 1941 onwards, was 124mm (4.88in) long, 55mm (2.17in) in diameter, and weighed 650g (1.43lb). The filler was 55g (1.94oz) of TNT. Casualty radius was about 20m (22yd).

The short-lived **RG-41** (Ruchnaya Granata-41) had a smooth liner and more complex fuse than its successor, the **RG-42** (Ruchnaya Granata-42), adopted in 1942. The fragmentation liner was a thin sheet of steel rolled into three layers with diamond-pattern segmentations. The RG-42 used the same UZRG lever-delay fuse as the F-1. These grenades required no casting and were produced in existing can-making plants. 121mm (4.76in) long and 54mm (2.13in) in diameter, they remained in use within the Warsaw Pact and Communist China (as the Type 42) after the Great Patriotic War.

The **RGD-5** distance hand grenade (Ruchnaya Granata Dstantsionnaya 5) was introduced in 1954. Produced in several Warsaw Pact countries and China (as the Type 59), it is found the world over. An RGD-5 was thrown at US President George W. Bush and the president of Georgia in 2005, but failed to detonate. Introduced in the mid-1980s, the **RGN**



Three grenades of the many types used by Finland in the 1939–40 Winter War: (left) Soviet RGD-33 with fragmentation collar; (upper right) Soviet F-1 with UZRG fuse removed; and (lower right) British No. 36M Mk II. Besides wide use in World War II, the F-1 was used in the Spanish Civil War and copied by Spain. It was manufactured by most Warsaw Pact states and remained in use even though more modern Soviet grenades were available. There are variations in production details between countries. Poland adapted the F-1 body to its post-war F-1/N-60 rifle grenade and produced the F-1 until the late 1990s. After World War II, Turkey produced the MKEK Mk 2 grenade using the copied F-1 body with a US-designed M204A2 fuse. The Yugoslavian M15 and M35 defensive hand grenades (obramben bomba rucna M15 i M35) were almost identical to the Russian F-1, but the 5.6-second friction igniters were of a different design. (Tom Laemlein/Armor Plate Press)



The RGN (left) and RGO (right) hand grenades measure 114mm (4.49in) tall and 60mm (2.36in) in diameter. The RGN has a smooth, spherical body internally scored to generate short-ranged aluminum fragments and has a casualty radius of 4–10m (4–11yd). The RGO has a two-layer pre-fragmented steel body and a casualty radius of 6–20m (6.5–22yd). The white plastic UDZS impact fuse arms after 1–1.8 seconds to detonate on impact, or after 3.2–4.2 seconds. The bodies are olive drab and the plastic fuse housings are white. (US Army)

The Soviet “zero-delay” fuse myth

The Soviet UZRGM lever-delay fuse (*Unifitsirovanny Zapal Ruchnaya Granaty Modernizirovannyy*, or “universal-fitting hand grenade fuse, modernized”) was used in the F-1, RG-42, and RGD-5. The delay is 3.2–4.2 seconds. In 1983, an American “action adventure” magazine published an article stating the UZRGM was provided with varied time delays ranging from 0 to 13 seconds at 1-second intervals. This misbegotten theory was based on a small stamped number on the fuse body concealed inside the grenade when inserted. This is not true. It fails to explain the actual 3.2–4.2-second standard delay for one thing, nor is there an external warning identification of “short” or “long” delays when inserted in grenades. It is absurd to think that there would be no form of warning on fuses set to detonate in less than 3 seconds. Additionally, they were randomly mixed in fuse-packing cans without any warning markings. While a zero-delay fuse is valuable for booby-trapping, it is hard to see what the value of 1- and 2-second delay fuses could be, much less any practical use of grenades with 6–13-second delays. *All* UZRGM fuses have the same 3.2–4.2-second delay regardless of the stamped number. The number indicates only the factory

production line. This myth actually found its way into the US Army's 1988 FM 23-30, *Grenades and Pyrotechnic Signals*, and was not deleted until the 2000 edition.



Grenades used by Communist Chinese and North Korean forces during the 1950–53 Korean War (left to right): Type 42 (Soviet RG-42), two different types of Chinese-made stick grenades, and a Type 1 (Soviet F-1). Communist China produced the F-1 as the Type 1 hand grenade as well as stick-grenade versions fitted to the fuse well containing a friction igniter. F-1s and Chinese Type 1s also saw use in Vietnam and various African conflicts. The stick grenade on its end was copied by the Japanese as the Type 98 (1938). The fountain pen for scale is about 140mm (5.5in) long. (Tom Laemlein/Armor Plate Press)

(*Ruchnaya Granata Nastupatel'naya*) and **RGO** (*Ruchnaya Granata Oboronitel'naya*) are blast and fragmentation grenades, respectively. They are widely distributed today, being produced in Russia and the Ukraine.

Japanese hand grenades

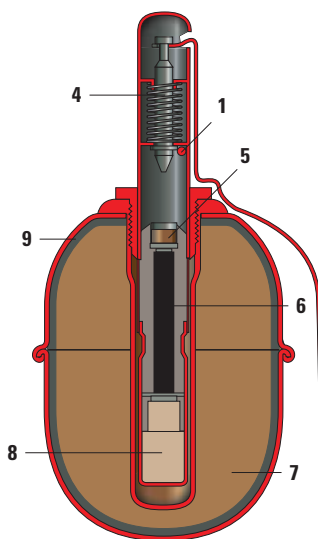
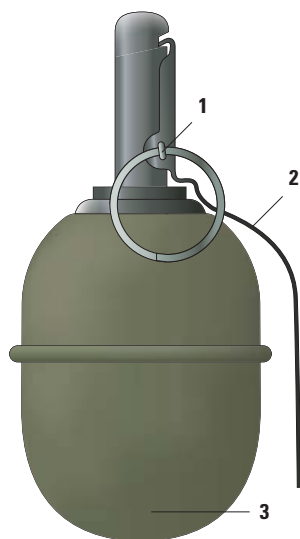
During the Russo-Japanese War the Japanese made wide use of expedient grenades little different from later British trench-made grenades. In

Japanese hand grenades: (left to right) Type 98 (1938) stick grenade copied from a Chinese model and produced in Manchuria; Type 97 (1937) hand grenade with zero-delay fuse for booby-trapping, identified by the white bottom; Type 91 (1931) hand and discharger grenade with “knee mortar” propellant charge attached; Type 97 (1937) hand grenade with standard 4.5-second delay; and Type 99 (1939) hand and rifle grenade, the “Kiska grenade.” These grenades were painted black and had brass covers on the percussion fuses. The tops were painted red to signify they had an explosive filler (except for the stick grenade). (Tom Laemlein/Armor Plate Press)



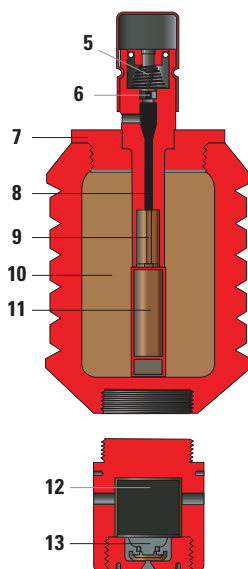
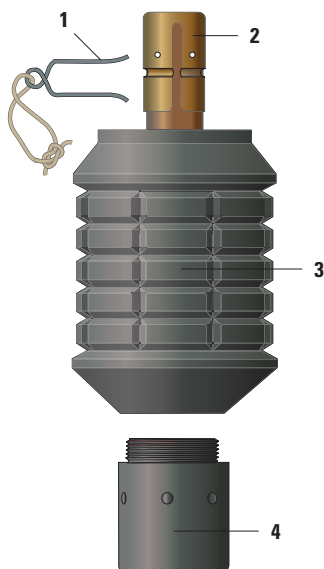
SOVIET AND JAPANESE GRENADES

Soviet RGD-5 hand grenade



1. Arming pin
2. Arming lever
3. Steel body
4. Firing pin and spring
5. Primer
6. 3.2–4.2-second delay element
7. TNT filler
8. Detonator
9. Fragmentation liner

Japanese Type 91 (1931) hand and discharger grenade



1. Two-prong arming pin
2. Protective cap
3. Cast-iron body
4. Grenade-discharger propellant charge
5. Firing pin, spring, and holder
6. Primer
7. Top filler plug
8. 7–8-second delay fuse
9. Igniter charge
10. Flaked TNT filler
11. Booster charge
12. Grenade-discharger propellant charge smokeless-powder filler
13. Grenade-discharger propellant charge primer

Oval-shaped, the Soviet **RGD-5** hand grenade is 117mm (4.61in) long and 58mm (2.28in) in diameter. Featuring a pre-scored fragmentation liner (300 fragments) and using the UZRGM lever-delay fuse, it is often assumed to be a blast grenade owing to its two-piece smooth body.

As a rifle grenade, the Japanese **Type 91** grenade had a tailboom assembly screwed into the base. As a grenade discharger round, the grenade had a propellant charge screwed into the base. A

two-pronged arming fork was pulled to arm the igniter before striking it on a solid object. When it was used as a mortar round or rifle grenade, the percussion igniter was not struck, but the pin pulled and dropped down the mortar tube or placed on the launcher. The recoil activated the firing pin to ignite the 7–8-second delay. The Type 91 was extremely unreliable, with frequent duds. Fragmentation was poor, with reports of grenades breaking into as few as two pieces. Others reported “dust-like” fragments.



Marine Raiders on Guadalcanal unscrew the fuses of small Japanese Type 97 (1937) grenades. They will pop the percussion caps after removing the detonators and delay fuse and then carefully scrape out the 2oz TNT filler. The demilitarized grenades would then be passed out as souvenirs. (Tom Laemlein/*Armor Plate Press*)

addition to pipe bombs – dynamite-filled with a mining safety fuse and blasting cap – they filled 37mm and 47mm gun cartridges with gun-cotton charges. One of the first models of purpose-made Japanese grenades was a multipurpose munition – the Taisho **Type 10** (1921) hand and discharger grenade. This HE grenade could be thrown as a hand grenade with a 4–5-second percussion delay fuse, or fired from the 5cm Taisho **Type 10** (1921) or the later **Type 89** (1929) grenade dischargers. A propellant charge and primer assembly could be screwed into the base well for the latter role. Weighing 565g

(1.25lb), 110mm (4.33in) long, and 50mm (1.97in) in diameter, the **Type 10** was replaced by the **Type 91**, but remained in limited use into the 1940s.

During World War II Japanese hand grenades – *kuichi shiki shuryūdan* (preceded by type number) – were of marginal quality, with light blast and fragmentation. It was recommended to Americans using them to throw such grenades immediately after activating them, owing to the possibility of short fusing. These grenades had percussion-type fuses initiated by striking the percussion cap on a solid object after pulling the safety pin. They were identified by black bodies and red tops, indicating an HE filler. The **Type 91** (1931) hand and discharger grenade was a multipurpose grenade that could be thrown as a hand grenade, fired from a spigot-type rifle grenade launcher, or fired from the 5cm **Type 89** (1929) grenade discharger (“knee mortar”). The **Type 97** (1937) hand grenade was a **Type 91** without the “knee mortar” propellant charge well. Cylindrical with a segmented body, both were 95mm (3.74in) long – or 126mm (4.96in) with charge – and 50mm (1.97in) in diameter.

The **Type 98** (1938) stick grenade had a screw-on cap on its hollow wooden handle, protecting a pull-cord and friction igniter. 179mm (7.05in) long and 50mm (1.97in) in diameter, it had a cast-iron head 6mm (0.24in) thick and providing poor fragmentation. It was copied from a Chinese model (which was also used by the Japanese) and produced in Manchuria by the Japanese. The **Type 99** (1939) hand and rifle grenade possessed an improved percussion igniter, as the **Type 91** and **Type 97** functioned poorly in North China’s cold. The **Type 99** had a non-segmented iron body providing limited fragmentation relying mainly on blast, which was limited using picric acid with a Trotyl booster. It could be fired from the **Type 100** (1941) cup-type rifle grenade launcher. It was called the “Kiska grenade” by US forces as it was first encountered by them on Kiska Island in the Aleutians in 1943.



USE

Grenades in combat

TRAINING

Grenade training is provided in most armies' basic training. Most soldiers, even in supporting services, are given at least minimal training. This includes identification of different types, safety, the basics of how grenades function, and throwing practice. Most armies provide little detailed instruction on the effects of grenades. This means they are not always used to their maximum effectiveness and can cause them to be more dangerous to the thrower and other friendly forces. Most armies have soldiers throw only one or two live grenades, mainly for confidence building. During wartime, especially with armies *in extremis*, there may be no opportunity to throw a live grenade. It was not uncommon, though, for veterans to require replacement troops to practice throwing live grenades before engaging the enemy. Often rocks, weighted tin cans, or chunks of wood were all that were available.



A US Army Vietnam-era basic trainee practices throwing an M30 dummy grenade (the practice version of the M26) from a foxhole. Trainees were taught to be aware of the paradox to prevent their striking it and dropping the grenade. (US Army)

Live-grenade throwing appears to be virtually standardized in most armies. Different throwing positions are demonstrated and each soldier practices the positions using dummy (inert) grenades. Practice grenades, which make a small smoke puff, are seldom provided at this stage. They are mainly used in force-on-force exercises. Other than the visual effect of the smoke puff showing where it lands, practice grenades do little to enhance training. "Instructor's Notes: Instructors will impress on men the necessity for common sense, care, and knowledge of the nature of grenades, but will not lay too much stress on the question of danger, which would cause lack of confidence and nervousness in handling" (*Small Arms Training. Grenade, Volume I, Pamphlet No. 13*, British Army, 15 July 1942).

Throwing a live grenade for the first time is stressful to most recruits, and instructors habitually give a motivational and assurance talk. An instructor accompanies each recruit to a throwing position. This not only protects the instructor from the grenade's detonation on the range, but an adjacent barrier or foxhole is provided into which they can duck if the grenade is dropped. Typically, the recruit is told that if he drops the grenade he is not to attempt to recover it, but to take cover and the instructor will recover and throw it. It is reasoned the instructor would have a cooler head, and for both men to scramble for the grenade would be dangerous. An over-nervous recruit or one who refused altogether would be given further reassurance and allowed to watch others throw grenades. This just about always gives him the pluck to take his turn. One soldier, after pulling the pin, threw his grenade before the order was given. When asked why, he claimed to feel it "swelling" in his hand.

Armies usually have an assault qualification course of some kind. This requires a soldier to move from position-to-position with full combat equipment and rifle attacking different targets with dummy grenades using different throwing positions at different ranges. The US Army Grenade Assault Qualification Course using dummy grenades and in use since World War II includes seven elements:

- (1) moving to a foxhole and engaging "enemy" silhouette targets at 35m (38yd);
- (2) moving to a bunker on a blindside and throwing a grenade into the firing port;
- (3) engaging a mortar position at 20m (22yd) from the kneeling position;
- (4) engaging "enemy" silhouettes from the prone position at 20m;
- (5) engaging a trench from kneeling position at 25m (27yd);
- (6) engaging a stationary vehicle from the kneeling position at 25m;
- (7) identifying five different types of grenades.

Each event is timed. From World War II to the 1970s the US Army included a dummy grenade throw for range and accuracy in the Army Physical Fitness Test. The Soviets likewise included a grenade throw in their combat physical fitness course. The reality is that most soldiers perfect their grenade skills in combat while experiencing a wide range of conditions, especially with respect to unusual and awkward throwing positions. They also learn the actual effects of grenades and just how dangerous they can be to friendly troops.

USE IN COMBAT

Grenade preparation

Grenades do require a degree of preparation before use. Most modern grenades are shipped with the fuses inserted. During World War II and earlier, grenades were packed without the fuses. They were packaged in one or two metal cans packed in the grenade case. The fuse was screwed in prior to entering combat. Some early grenades were protected by a wax coating, which had to be removed. Some of the British and French explosives used in World War I and World War II grenades could ignite with friction. If loose grains had infiltrated into the fuse well, screwing in the fuse could detonate it. The fuse and its well had to be thoroughly cleaned. The cotter (split) pins were spread wide apart at the factory and these were partly straightened before entering combat, but not too much so the arming pin would not slip out.

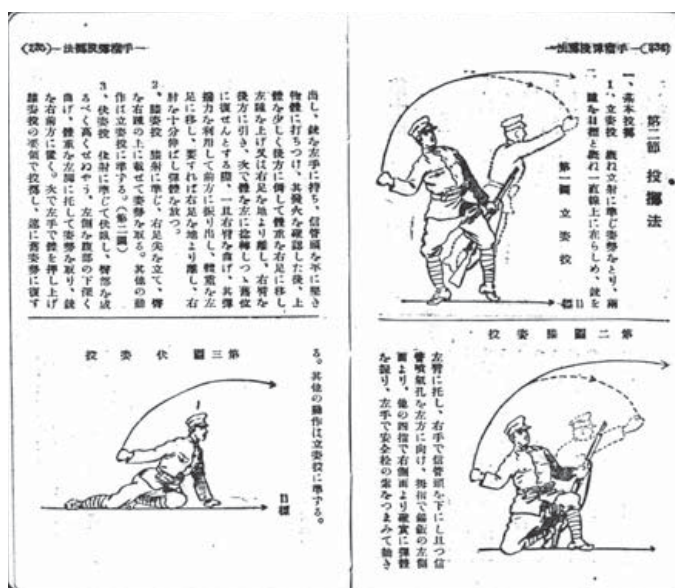
Throwing positions

Grenade throwing positions were similar among most armies. Standard positions were prone, kneeling, and standing, usually from behind cover owing to some fragmentation traveling beyond the advertised casualty radius. The British 1942 grenade pamphlet (Pamphlet No. 13) advised:

These grenades cannot be “thrown” in the strict sense of the word by the average man. They require to be delivered at a high angle, and the best way of achieving this delivery is by an overarm swing similar to bowling cricket. Accuracy should be the first consideration. This is obtained by a free and natural swing, which should be vigorous.

In spite of the conflict between “cannot be ‘thrown’ ... by the average man” and “a free and natural swing,” this form of grenade throwing originated from throwing grenades from deep trenches and behind walls in World War I. Using one’s energy to achieve a higher arc diverted that strength for throwing to a longer range with a lower trajectory. Theoretical throwing ranges were often optimistically high, up to 50m (55yd). Of course there are a wide range of grenade weights, but realistically 30–40m (33–44yd) can be achieved in combat conditions – although there are always exceptions.

A Japanese manual of the interwar period demonstrates the three common throwing positions used by virtually all armies: prone (in this instance the thrower has risen to better observe the target), standing overarm, and kneeling. Most armies taught soldiers to continue to observe target and follow the grenade’s track to confirm the target was neutralized or if follow-on grenades were necessary. The reality of combat typically saw the thrower ducking for cover immediately after releasing the grenade. (Courtesy of Akira “Taki” Takizawa)



Regardless of how far a soldier can throw a grenade in training, it is a different matter in combat. Exhaustion, stress, lack of sleep, and poor diet degrade performance. Wearing combat equipment and carrying a weapon also influence throwing range. Heavy layered winter clothing and gloves/mittens seriously affect throwing and can cut the range by half. Awkward throwing positions demanded by combat or throwing from confined positions also reduce range.

The current US grenade field manual (FM 3-23.30, dating from 2000), describing the same techniques found in earlier editions dating as far back as the 1940s, prescribes the standing position: “[It] is the most desirable and natural position from which to throw grenades. It allows you to obtain the greatest possible throwing distance. Soldiers normally use this position when occupying a fighting position or during operations in fortified positions or urban terrain.” Constant pressure must be maintained on the lever once the arming pin is removed. If pressure is relaxed, the striker may rotate, igniting the delay fuse while the lever is still attached, unknown to the grenadier. This is called “milking.” A natural overhand throw is used, observing the target beforehand and immediately taking cover after throwing.

The kneeling position reduces the distance a soldier can throw a grenade. It is used primarily when a soldier has only a low wall, a shallow ditch, or similar cover to protect him. The prone position reduces both distance and accuracy. It is used only when an individual is pinned down by hostile fire and is unable to rise to engage his target. It is also employed when only very low cover such as a fallen tree, shallow gully, or similar cover is available. Basically, a grenade throw from the prone position is accomplished by lying on one’s back and rolling toward the target as the grenade-arm is flung. The same American manual recognizes:

Since few soldiers throw in the same manner, it is difficult to establish firm rules or techniques for throwing hand grenades. How accurately they are thrown is more important than how they are thrown. If a soldier can achieve more distance and accuracy using his own personal style, he should be allowed to do so as long as his body is facing sideways, towards the enemy’s position, and he throws basically overhand. (FM 3-23.30)

Many Americans simply equate grenade throwing to baseball throwing. An individual’s stature has a bearing on one’s ability to throw grenades. The Japanese kept their grenades small, recognizing strength shortcomings. A Japanese document captured by the Americans, *Lessons from Actual Experiences in Eastern New Guinea Operations, July 1942–April 1943*, discusses the use of weapons in the jungle. It states, “The regular hand grenade is inconvenient to throw. We are able to throw grenades up to 20–25m [22–28yd], whereas the enemy throws them 50 meters [55yd]. It is necessary to train diligently in throwing hand grenades as prescribed in the training manual.” The document goes on to suggest that regular grenades could be improved by adding a “Chinese-type handle” (stick grenade) and that an ordinary person could throw such a grenade 40–50m (44–55yd).

Arming the grenade

Once the arming pin is pulled, it can be reinserted if the grenade is not needed. However, it is recommended that pins not be reinserted as the striker could be inadvertently released while realigning the pin holes in the lever and the fuse housing. It is advised to go ahead and throw the grenade if not needed. When handling a grenade with gloves it may be difficult to feel if the lever is released too much and the striker released.

Movies often depict a soldier pulling an arming pin with his teeth so his weapon would remain in his hand. Unless the cotter pin was completely straightened, this could damage teeth. It was done, but not often. Rather than a ring, Italian grenades had a rubber tab that could be pulled with the teeth. During World War II most grenades made a faint “pop” sound when the arming lever was released, and they may have released sparks or a faint stream of smoke. This might have alerted the enemy to incoming grenades, enabling them to avoid them or throw them back. Japanese percussion-activated grenades made a distinctive pop and American troops learned to rush forward when hearing it, to avoid incoming grenades. Late in the war, “silent fuses” began to appear. Some grenades still cause a faint snap and a ping when the lever flies off.

A risky technique sometimes employed to prevent the enemy from throwing back grenades is termed “cooking-off” or “cooking a grenade.” The arming pin is pulled, the lever released, the thrower counts to two or three – 2 seconds is sufficient, and safer – and then throws it. One has to have great confidence in the manufacturer’s quality control. It is unsafe to “cook-off” or “cook” a grenade and it is not recommended.



British infantry of 17 Platoon, H Company, 2nd London Irish Rifles hurl hand grenades during an attack on a German strongpoint on the southern bank of the River Senio, Italy, on March 22, 1945. (© IWM NA 23243)

Throwing the grenade

To throw a grenade regardless of position the following considerations are taken, according to FM 3-23.30:

- (1) Observe the target to establish the range between the throwing position and target. Be aware of any obstacles in the throwing zone. In observing the target, minimize exposure time (no more than 3 seconds).
- (2) Firmly grip the hand grenade in the throwing hand.
- (3) Grasp the pull ring with the index or middle finger of the non-throwing hand. Remove the safety pin with a pulling and twisting motion. If the tactical situation permits, observe the safety pin's removal.
- (4) Look at the target and throw the grenade using the overhand method so the grenade arcs, landing on or near the target.
- (5) Allow the motion of the throwing arm to continue naturally once the grenade is released.
- (6) Immediately duck behind cover and after the detonation quickly observe the target to ensure it was destroyed.

While most grenade throwing is done overhand, the underarm throw is sometimes necessary to avoid low-hanging vegetation and other obstacles. Obstacle avoidance is critical to ensure the grenade reaches the target and does not bounce back toward friendly troops. It is especially critical if using an impact-detonated grenade, as the obstacle may detonate the grenade too close to the thrower. A sideways or side-handed throw may be necessary to avoid obstacles, toss it into a small opening, or throw it around a corner of a building or trench angle. This tends to be less accurate except at close ranges.

Risks to the thrower

Care has to be taken when throwing grenades from vehicles such as a halftrack, truck, or tank turret to avoid radio antennas and other fixtures. A moving vehicle jolting about might cause one to lose his grip on a grenade. Crew-members of transport aircraft, gliders, and helicopters were extremely nervous of grenades handled by passengers. They were to be kept stowed and never under any circumstances dropped from aircraft. That said, there were instances of spotter planes and helicopters dropping grenades, but by aircrewmembers and usually only smoke grenades for target marking. The first aircraft bombs were in fact grenades and saw use early in World War I. Grenades dropped from aircraft were held outside the aircraft's confines, armed, and immediately dropped.

Many troops learn grenade safety issues the hard way – in combat and suffering casualties. Employing safe carrying means is one way of reducing risks to the user. Others include: occasional fragments traveling far beyond the safety radius; erratic and uneven fragmentation patterns; blast and fragmentation muffled by snow and mud; and smoke grenades starting unintentional brush and grass fires, which even in combat cause problems. Some problems are more serious. A slight miss when throwing a grenade through a window, door, or firing port could mean a bounce-

back toward friendly troops. There is no room for error at extreme close ranges. An example of employing grenades to reinforce the advance – and the risks to the thrower associated with throwing grenades in cramped confines – is furnished by the actions of Sergeant Herbert J. Thomas Jr. of the US Marine Corps, as reported in his Medal of Honor citation:

For conspicuous gallantry and intrepidity at the risk of his life above and beyond the call of duty while serving with the Third Marines, Third Marine Division, in action against enemy Japanese forces during the battle at the Koromokina River, Bougainville Island, Solomon Islands, on November 7, 1943. Although several of his men were struck by enemy bullets as he led his squad through dense jungle undergrowth in the face of severe hostile machinegun fire, Sergeant Thomas and his group fearlessly pressed forward into the center of the Japanese position and destroyed the crews of two machineguns by accurate rifle fire and grenades. Discovering a third gun more difficult to approach, he carefully placed his men closely around him in strategic positions from which they were to charge after he had thrown a grenade into the emplacement. When the grenade struck vines and fell back into the midst of the group, Sergeant Thomas deliberately flung himself upon it to smother the explosion, valiantly sacrificing his life for his comrades. Inspired by his selfless action, his men unhesitatingly charged the enemy machinegun and, with fierce determination, killed the crew and several other nearby defenders. The splendid initiative and extremely heroic conduct of Sergeant Thomas in carrying out his prompt decision with full knowledge of his fate reflect great credit upon himself and the United States Naval Service. He gallantly gave his life for his country.

Another problem is coordination within small units. Inexperienced units often fail to adequately warn all troops when grenades are thrown and this is especially dangerous when undertaking fire and maneuver with exposed troops. “Grenade,” should be shouted when throwing a grenade or when detecting incoming enemy grenades. Of course this can alert the enemy to incoming grenades, as many use a variant of the term “grenade.” It is not uncommon for grenadiers to be hit by fire when exposing themselves. This can result in dropping a grenade and perhaps casualties among friendly troops – another reason to warn nearby friendly forces. Covering fire is essential.



Two 1st Marine Division riflemen on Peleliu, 1944, throw Mk II fragmentation grenades while covered by a BAR man and rifleman (not visible). The covering men not only protected the grenadiers, but to shoot down any enemy flushed out of hiding by the grenades. Note the grenadier to the right – his grenade is smoking profusely, a common deficiency in many World War II grenades, which might enable an enemy soldier to find a grenade quicker and throw it back. (US Marine Corps Historical Center)



A No. 23 grenade prepared for use as a rifle grenade. The No. 23 Mk I differed from the No. 5 with improvements to the fuse, differently shaped lever brackets, and the base plug was tapped for a 5.5in rifle bore rod. It could be launched from a rifle from a No. 1 Mk I grenade cup. Some 30 million No. 23s were produced before production ceased in March 1918. It was declared obsolete in 1921. No. 5, No. 23, and No. 36 grenades were varnished inside and out, which usually appeared dark brown or almost black. The red band at the top signified it was filled with explosive. (© IWM MUN 1385)

GRENADE TACTICS IN WORLD WAR I

Owing to the nature of World War I trench warfare, grenades reemerged as important weapons, used both offensively and defensively. Initially, most armies considered grenades as specialist weapons employed by engineers. By late 1915 doctrine was revised, however, accepting that all infantrymen had to be proficient with grenades.

British practices

Abandoning the concept of grenades being limited to the Royal Engineers, in late 1915 the British Army specified that all officers and 12 NCOs of each rifle company be trained in division schools to employ grenades. They would then instruct their companies. Training with live grenades was emphasized to maximize exposure to explosives. Regardless of all troops receiving grenade training, it was recommended for platoons to establish an especially trained “bombing reserve” of eight men under an NCO. They were to be selected from the best, bravest, and steadiest men with greater-than-average height and arm reach, a description not unlike that of the earliest grenadiers. For trench assaults “grenadier parties” or “bomber parties” were organized. Led by an NCO, these comprised: two “bayonet-men” to clear trenches; sharpshooters; two bomb-throwers; two grenade-carriers with canvas buckets, sandbags, or baskets of grenades; and two spare men to protect the rear and replace casualties. Such parties were employed ahead of the main assault or conducted trench raids to take prisoners or destroy critical enemy positions. The bomber party would be supported by other troops. There were of course many variations of these tactics.

At night, the party would silently infiltrate the target trench with the bayonet-men forward. If the trench section was unoccupied the party would enter quietly. If it was occupied the bayonet-men might attack – preferably without firing – or the bomb-throwers would bomb the trench section, and the party would enter. The spare men or supporting troops would block one end – or both ends – of the trench and clear dugouts, with two grenades per dugout. The bombing party would move to the first trench angle in the opposite direction and bomb the next traverse (straight stretch of trench between angular turns). The bayonet-men charged around the corner to finish off enemy survivors and moved to the next traverse. In a large-scale assault there would be multiple bombing parties taking designated trench sections and the trench would be cleared in both directions. To supply sufficient grenades, bomb depots were established in the forward trenches and carrying parties organized to take them across no man’s land to the assault troops. Carrier relays trudged back and forth across the blasted ground with cases of grenades lashed to Yukon packboards. A brigade’s units held a 5,000-grenade reserve. Captured grenades were also used, on which bombing parties were trained.

In 1916 the doctrine was refined, emphasizing that bombing parties maintain their expertise with rifles. Bayonet-men were to be the primary means of clearing trenches, rather than routinely bombing each traverse without determining whether it was occupied. This was because such

methods resulted in excessive grenade waste and could also lead to grenade fights, using up valuable time and inflicting high casualties on both sides. Bombing-party duties became more specialized, with one bomber focusing on short ranges and the other on longer ranges. During raids the throwers were now armed with revolvers, bayonets, knives, axes, and clubs rather than cumbersome rifles. They slung rifles with bayonets fixed during assaults, though. The Germans often outranged British bomb-throwers when using lighter egg grenades. The British countered this by using rifle grenades. Regardless of directives on bombing-party organization and tactics, units often differed in practice owing to their experiences.

On many World War I battlefields, the British had to confront and overcome pillboxes and other German fortifications; these often proved to be the linchpin of the enemy defense, so their suppression and capture was of paramount importance. During October 1917 New Zealand troops fighting in the grim Passchendaele battle were required to defeat a large emplacement known as Otto Farm. After outflanking it, the New Zealanders used Mills Bombs to kill or wound the occupants; as recounted shortly after the battle by one historian, “they burst in the confined space with a ghastly effect” (quoted in Harper 2007: 44). The central importance of grenades in combat can be gleaned from an entry from the War Diary of 1/8th Battalion, The Royal Warwickshire Regiment, for July 1, 1916 – the first day of the battle of the Somme:

Enemy first line reached and passed very quickly as also was the second. Only in one or two cases were any enemy seen in the two lines. Having plenty of casualties from machine-gun fire in enemy third and fourth line. All the third line men were temporarily held up by machine-gun fire but

A bombing post, Flanders, 1916 (overleaf)

In the British Army, originally only sappers of the Royal Engineers were trained as bomb-throwers. This involved more than simply throwing hand grenades. The training included offensive and defensive tactics, transporting grenades, fusing them – a dangerous procedure with certain marks – and proper storage and protecting them from the elements in front-line positions. The reforms of 1915 directed that all officers and 12 NCOs from each rifle company attend divisional training courses conducted by the engineers on all aspects of grenades, both hand and rifle. They were to pass this on to their troops. Properly throwing a No. 23 Mills Bomb or any hand grenade was accomplished through a three-stage procedure, demonstrated by the three figures shown here (right to left). (1) The grenade is held in the right hand, ensuring the arming lever is firmly gripped. A finger is placed through the arming ring and it is pulled. (2) Facing the target, the bomber pivots his left foot toward the target. The right arm with the grenade is extended rearwards and downwards. The eyes are fixed in the direction

of the target with the left shoulder pointing toward the target. Swing back as far as possible, allowing the left arm and foot to come up naturally as the right arm is swung toward the target. (3) The right arm is slung overhand, placing one’s weight behind it and his weight on the left foot, with the heel of the right foot raised. If possible, the fall of the grenade is observed until impact. The man on the right wears a ten-pocket grenade vest. A similar vest for fewer grenades was locally fabricated using a sandbag, web straps and rope. Holding up to 20 Mills Bombs each, 2-gallon canvas water buckets were used to carry fused grenades from fusing points in the rear; these were also carried by spare bomb-throwers during trench attacks and raids. Niches were dug in trench walls for ready grenades and marked with a sign – BOMBS. Resting on the trench step are two 2lb No. 7 Mk I heavy fragmentation grenades. There was a similar 1lb No. 6 Mk I light blast grenade, both obviously called ‘lemon grenades’. Beside them are three No. 16 ‘oval pattern grenades’; this crude friction-fused grenade was a stopgap, as insufficient numbers of Mills Bombs could be produced.



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took it by rushes. From this point the fighting was all with bombs [grenades] along trenches. We reached our objective probably 35–40 minutes from zero hour and at once commenced consolidating and cleaning rifles. By this time the next battalion was arriving but had had so many casualties that they could not go through so helped consolidating. Many times we were bombed from this position and regained it until bombs ran out. We had to retire to the third line parapet and hold on with machine-gun and rifle fire. Parties were detailed to collect as many bombs as could be found (both English and German) and when we had a good store we again reached our objective. No supply of bombs were coming from rear so could not hold on and retired again. Held on to this position until relieved by a battalion from rear.

German practices

The German *Pioniertruppen* (combat engineers) originally employed grenades, but they were soon in use by the infantry. There was no specified organization; units developed their own techniques in the form of ad hoc *Stoßtruppen* (shock troops). In 1915 the 6–8-man *Handgranatetrupp* (hand-grenade team) was specified for each platoon. Members were volunteers who demonstrated grenading skills, strength, and brashness.

Platoons in the defense positioned their *Handgranatetruppen* in a central location as a platoon “reserve.” If the enemy assault gained a trench section and the defenders were unable to eject them, the *Handgranatetrupp* conducted a local counterattack without orders. They also barricaded trenches to contain the enemy. Grenade boxes were dug into trench sides for immediate use, but it was found that the enemy sought these out for their own use. When the team attacked – and this applied to when entering enemy trenches – two grenadiers were in the lead, armed with all the grenades they could manage plus pistols, knives, and slung rifles with bayonets. The team leader was similarly armed. If pistols were not available, the leader covered the lead men with his rifle. They advanced in a crouch, enabling the leader to fire immediately over their heads. The rest of the team followed to the rear with rifles and bags of grenades. They remained one traverse to the rear, but kept the leader in sight and ready to resupply grenades and replace casualties. They advanced after grenading the next traverse, much like the British did. If the team was halted or had barricaded the trench, the two grenadiers manned the barricade covered by the leader and grenade-carriers from the first traverse to the rear.

In 1916 refinements were made. A *Handgranategruppe* (hand grenade squad) of nine men was employed, divided into two four-man *Truppen*. Each *Trupp* had two grenadiers and two grenade-carriers who doubled as covering men. If a heavy grenade barrage was necessary, all four threw. The grenadiers had pistols and the carriers had rifles, each man carrying at least six grenades. The rear team was rifle-armed and carried 25 empty sandbags for barricading. Rifle companies sometimes consolidated the three platoon-level *Handgranategruppen* into an assault unit to lead assaults or counterattacks. They were also used to conduct trench raids, mainly to capture prisoners. Raids tended to be well planned and rehearsed. This concept of hand-picked,

experienced, aggressive specialist troops led to the formation of the first *Sturmtruppen* (assault troops) in the spring of 1916. *Sturmtruppe* volunteers often came from unit *Handgranatengruppen*, but infantry units still fielded their own grenade subunits.



An overly camouflaged German grenadier prepares to throw a stick grenade. Being encumbered by camouflage, grenades, rifle, wire-cutter, and other equipment will restrict his throwing range. A concentrated charge (*Geballte Ladung*) with six stick-grenade heads secured around a seventh grenade with its handle sits ready for use. Note the friction igniter's pull-cord pulled out of the grenade's handle. (Tom Laemlein/Armor Plate Press)

French practices

The first squad of each rifle platoon was organized as grenade-throwers – *escouade de grenadiers* – and included a corporal, two grenadiers, two assistant grenadiers, two carriers, and one connecting file (spare). It could be split into two teams – *équipe* – each with a leader, grenadier, assistant, and carrier. Grenadiers could throw grenades up to 45m (49yd) with 2–3m (2–3yd) accuracy. All members could throw grenades and were armed with rifles, bayonets, knives, and pistols. Each battalion had an officer detailed from a company to train all grenadier squads. Any number of the battalion's nine grenadier squads could be consolidated under his control to spearhead assaults. Grenade-throwers typically left their rifles behind during raids, but retained them for assaults to fight off counterattacks. Baskets and belts were provided to carry 30 grenades per thrower. The squads were employed for:

- (1) defense of a trench section in close-range fighting;
- (2) seizing a trench or its approaches in stages;
- (3) grenading a trench section before the main attack;
- (4) close-range fighting within an enemy trench system; and
- (5) trench raids.

In defending a captured trench section, if possible a crater was blown inside the trench on the enemy's side of a traverse and sandbag barricades erected on both sides of the crater and covered by grenadiers and riflemen. When seizing a trench, in a step-by-step trench clearing, a minimal number of grenadiers were forward and the rest to the rear to protect the party from countergrenading. Two carriers were positioned between the grenadiers and the rest of the squad to resupply grenades and immediately replace casualties. This was exhausting, and reliefs were frequent. Crowding in the trench was avoided. Except when actually engaged, the troops were expected to be quiet so enemy voices and movements could be detected. Trench raids were conducted by small, specially selected teams. These were trained to:

- (1) occupy a small section of trench prior to the main assault;
 - (2) attack the head of a sap approaching a friendly trench;
 - (3) seize and hold or destroy a forward position under construction;
- or
- (4) capture an outpost or small trench section to seize prisoners.

Trench raids were to be rehearsed, a detailed reconnaissance conducted, routes selected, covered positions selected for grenadiers, each sub-unit assigned specific tasks, a resupply system arranged, and coordination made with the covering infantry and artillery.

French grenade use in the assault was documented in an after-action report filed by a defending German infantry regiment in late 1915:

The first French attacking line consisted of a thin skirmish line equipped with hand grenades. As soon as this had reached our front

line trenches, attacking columns in close order left the enemy's trenches. These consisted either of parties about 50 strong, formed in columns of fours, or irregular lines in close order. For purposes of close combat, the French were armed with bayonets and hand grenades. Whereas in the trenches the fighting was principally carried out with hand grenades, in the open country the bayonet was successfully employed by the companies of our regimental reserve during the counter-attack. (Quoted in Bull 2007: 42)

US practices

The AEF arrived in France in 1917–18 without any suitable grenades, or even grenade training, although earlier observers had reported their need. Copies of French grenade manuals were translated into English. Doughboys were provided with French F1s and British Mills Bombs. Both countries took the opportunity to rid themselves of the less-than-successful grenades still in stock. Once in France, AEF divisions established grenade schools, often run by French instructors. Divisions training in the States commenced grenade instruction. Few US-made grenades saw combat, and French and British grenades remained the doughboys' mainstays. The Americans, who were largely trained by the French and used translated French manuals, employed variations of these techniques. There was some British influence in US divisions serving alongside British formations.



American doughboys creep through no man's land equipped with hastily made grenade carriers fabricated from sandbags, a common practice among all the belligerents. They most likely carry French-made grenades, the Americans' primary source of grenades. (US Army)

GRENADE TACTICS IN WORLD WAR II AND AFTER

Trench-warfare tactics would endure as doctrine into the 1930s, but by 1939, with the recognition that mobile warfare was more likely, they began to fall from favor. During World War II grenades continued to play a key role on the battlefield, and could provide decisive. On November 23, 1943 Sergeant Thomas C. Derrick of the Australian 2/48th Infantry Battalion withstood enemy grenades and employed his own to win the Victoria Cross at Sattelburg, northeast New Guinea. According to the *London Gazette* of April 24, 1945:

Sergeant Thomas Currie Derrick, D.C.M., was in command of a platoon of a Company of Australian Infantry ordered to attack a feature from the township of Sattelburg. For over two hours many unsuccessful attempts were made, under heavy fire from enemy strong points at the top of a precipitous cliff which the Company had to scale to reach the objective. The task appeared impossible, and shortly before last light the Company was ordered to retire. Sergeant Derrick

Finnish soldiers prepare to throw German-supplied Stg 24 stick hand grenades. The man to the left is pulling the cord of the friction igniter to activate the delay train. During the 1939–40 Winter War the Finns used grenades gathered from all over Europe. During the 1941–44 Continuation War against the Soviet Union, they mainly used German and captured Soviet grenades. (Tom Laemlein/Armor Plate Press)



requested, and was granted, permission to make one last attempt. Moving ahead of his forward section he personally destroyed with hand grenades an enemy post which had been holding up this section. His second section were heavily attacked by machine guns and grenades from six enemy posts. Without regard for his personal safety he went ahead of the leading men and with grenades so completely demoralised the enemy that they fled leaving weapons and grenades. The Company was thus enabled to gain its first foothold on the precipitous ground. Then on four separate occasions Sergeant Derrick dashed forward and threw grenades at a range of 5 to 7 metres until the remaining three posts were silenced. In all he reduced ten enemy posts, and from the vital ground he captured the Battalion moved on and took Sattelburg. Undoubtedly the capture of Sattelburg was due to Sergeant Derrick's fine leadership and refusal to admit defeat in a seemingly impossible situation. His outstanding gallantry, thoroughness and devotion to duty were an inspiration not only to his platoon and company, but to the whole Battalion.

For all practical purposes there were no formalized grenade tactics; it had become an individual weapon. Of course, small assault and tank-hunter teams were utilized when assaulting fortifications and built-up areas, but were less rigidly organized.² The grenade provided the infantryman's "pocket artillery" and was considered an essential, basic weapon along with the rifle, bayonet, and light machine gun. The war's belligerents employed very similar grenade techniques, mostly based on the two-man team. Either man could throw the grenade; the other protected the thrower, provided suppressive fire, and observed the flanks to detect enemy movement.

Since World War II grenade employment has changed little; with years of standardization practices within alliances and extensive combined training between armies, they have much more in common than not. Western armies and partner armies that have trained worldwide use very

2 Osprey Elite 160, *World War II Infantry Assault Tactics* and Elite 124 *World War II Infantry Anti-Tank Tactics*.

similar tactics and techniques. Stun grenades have come into wide use by both military and police forces for counterterrorist operations. They too can cause casualties among hostages and other non-combatants if used improperly – mainly hearing and vision injuries.

Defensive use

In the defense, grenades were thrown when small groups of enemy or crew-served weapons were detected. Concealed approaches (gullies, ditches, vegetation, dead space – low ground not under observation or fire, etc.) would be grenaded. Antipersonnel obstacles which the enemy was attempting to breach would be grenaded, as the enemy was delayed and perhaps bunched up. Grenades were especially valuable when close-range fields of fire were restricted. When defending steep hills, riflemen had to expose themselves more to fire downhill. Grenade barrages were effective against attackers caught in the open or pinned down. If even a small part of the attack force was routed by concentrated grenades and followed by grenades, it could cause a general withdrawal.

In the Pacific, Japanese infiltration of Allied lines was common. They also probed positions in an effort to cause automatic-weapons crews and even riflemen to reveal their positions. Rather than being fired upon, infiltrators would be grenaded without revealing positions. Grenades were sometimes inserted in ration tins with the lever on the outside, the pin pulled, and rolled down clear hillsides. In August 1943 a company of 1st Battalion, 162nd Infantry was cut off and surrounded for two days by the Japanese at Salamaua, New Guinea. The company repelled nine Japanese assaults and was low on ammunition, including grenades. At night the Japanese probed and attempted to infiltrate. There were also wild animals

Soviet front-fighters (*frontoviki*) armed with PPSH-41 submachine guns prepare to receive an attack. An F-1 and two RG-42 hand grenades sit ready for use in the straw-camouflaged position, what the Germans called a “Russian hole” (*Russischloch* or *Rusloch*). (From the fonds of the RGAKFD in Krasnogorsk via Stavka)



in the area and since the company was low on grenades, rather than waste one on a pig or land crab, they first threw a mud-ball (rock, wood chunk) at the sound. If the noise continued it was an animal. If it stopped it was an infiltrator and a grenade followed. In desperate situations and out of grenades, the Americans threw rocks with shouts of “Grenade!” to give the attackers pause. Unverified reports have claimed attackers were run off by throwing rocks with occasional grenades added. There were instances when Japanese troops threw smoke grenades and shouted, “Gaz!”

Offensive use

In the attack at least two grenades were carried by most individual combatants. Four and more were frequently carried and designated individuals might carry more, with further grenades held in reserve. Units newly committed to combat frequently underestimated the quantities of grenades necessary and their rate of expenditure. The final assault on enemy positions was often preceded by a grenade barrage from the last available cover within range. A shower of grenades just before the charge added to the shock effect. Care had to be taken to await the grenades’ detonation before springing to one’s feet. Smoke grenades might be ignited before the fragmentation-grenade barrage. This blinded the enemy, preventing him from seeing attackers. However, the smoke could hamper the attackers by masking obstacles, booby traps, and even enemy positions. They could become disoriented and move in the wrong direction.

Bunkers, pillboxes, and covered positions were routinely grenaded, often with two grenades if large. Clearing trenches and lengthy gullies and ravines was conducted similarly to World War I techniques. There were variations between armies, but differences were minor and units developed their own based on experiences, terrain, and enemy tactics. Trench clearing, and building and other fortification clearing, was – and continues to be – typically conducted by 2–5-man teams. The trench was grenaded and then entered by the team, who fired in both directions. Two men held the entry point and provided covering fire. The lead man threw a grenade down each trench traverse and after the detonations, fired down the trench and advanced. At least one man covered him. Other men provided covering fire at surface level, while another protected the clearing team’s rear.

Attacking a bunker or pillbox required close coordination. Seldom could one or two men take a bunker alone. It required supporting machine-gun and rifle fire, not only to suppress the target bunker, but also positions covering the bunker itself. The attackers needed to approach from the flanks not covered by other enemy positions, unless they were effectively suppressed, including with mortars and smoke. Every effort had to be made to attack the rear (side) entrance and not firing ports, unless left with no recourse. Multiple grenades and large demolition charges were necessary. Use was made of double grenades – two grenades taped and/or wired together. American troops sometimes taped a 0.5lb TNT charge to a Mk II frag. On Luzon US paratroopers found Japanese Type 91 hand grenades fired from “knee mortars” which had not exploded because the arming pins had not been pulled. Paratroopers removed the

spent propellant container and taped them under their own Mk II frags.

Room clearing was undertaken by at least two men, preferably backed by one or two cover-men. The building's construction was important to consider, be it thatch, boards, brick, cinderblocks, or concrete. If walls could be fired through, doing so would be most effective before the attackers entered the room. Doors were battered, kicked, or blown in. Soldiers entering the room moved away from the door so as not to be silhouetted. They had to be prepared to react to any situation encountered. As other team members entered the room they were instructed to shout "Coming in," and "Coming out" when exiting.



Use in breaking contact

Since the US involvement in Vietnam the employment of reconnaissance and other small direct-action teams has been widespread in counterinsurgency, counterterrorism, and other special operations. A 4–12-man team in enemy territory needs every advantage it can gain. A small team cannot survive for long if pinned down by a larger enemy force with reinforcements on the way. It must immediately break contact and evade the enemy. Immediate-action drills – break-contact drills – are crucial. Grenades provide firepower advantages. A technique developed in Vietnam was the “peel back” or “banana peel,” allowing a team to quickly break contact with a superior enemy.

When engaged, the immediate response was for all who could bring their weapons to bear on the enemy to open fire. If the enemy fire was

A World War II US soldier at Cassino in Italy handles a German concentrated charge (*Geballte Ladung*) made up of a central Stg 24 stick grenade as a detonator and six grenade heads secured to it with wire or twine. Together they contained 42oz TNT. Often captured foreign hand grenades with the fuses removed were used as the outer charges. Concentrated charges were thrown in tank treads or on engine decks and tossed into firing ports. The concept was developed in World War I as one of the first German AT weapons. (Tom Laemlein/Armor Plate Press)

Current NATO grenade color codes

The US Revised Color-coding System (MIL-STD 709C) was adopted in May 1976 to standardize ordnance identification within NATO and is based on the US Standard Color-coding System introduced in January 1961. This system is used by many non-NATO countries.

Grenade type	Body color	Band/markings color(s)
Fragmentation	OD	Yellow
Incendiary	Light red	Black
Smoke, burning-type	Light green	Black*
Smoke, WP	Light green	Yellow band, red markings
Chemical, riot control	Light gray	Dark red
Stun	OD or black	Light green band, white markings
Practice	Light blue	White**

* Colored smoke grenades' top marked in smoke color.

** Light brown band indicates low explosive marking charge.



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Breaking contact in Vietnam (previous pages)

In Vietnam US reconnaissance teams (RTs) of 4–12 men were assigned to long-range patrol/Ranger companies, Special Forces special projects, MACV-SOG, SEALs, and Marine force reconnaissance. These small independent-action teams operated in enemy-controlled areas, often out of range of artillery, and attack or extraction helicopters required considerable time to arrive on-station. RTs avoided contact with the enemy, who actively sought them. For a small team to be discovered deep within enemy territory was a situation to be avoided. A compromised team was on its own for some time. While well trained and heavily armed, they were always outnumbered and as additional pursuit forces were marshaled, often outmaneuvered – no matter how skilled and agile they were. Various types of grenades were often used in unconventional manners never prescribed in manuals to give them an edge. M61 (M26A1 with safety clip) and M67 frag grenades could be attached to the sides of M14/M16 rifle-magazine pouches secured by a snapped strap. Two frags could be carried inside a pouch. Some RTs used World War II M1937 six-pocket BAR belts, each pocket holding four M16 magazines or three grenades. Four grenades could be carried in a 1qt canteen cover. Some troops carried grenade arming pins in boonie hat camouflage loops and helmet camouflage bands to re-pin unthrown grenades or disarm grenade-based booby traps. Owing to the dense vegetation, the man on the right is throwing a frag underhanded. Inexperienced VC/NVA rear area troops encountered by RTs could be panicked by a shower of grenades and automatic fire. Larger, beer can-sized smoke and chemical grenades could not be carried in the same manner, so were typically attached to rucksacks. The arming levers were inserted through rucksack equipment loops and the lever easily

bent to secure it. M18 colored smoke grenades (OD body, smoke-colored top) were provided in red, violet, yellow, and green. Red meant danger, that the RT was engaged or warned away approaching extraction helicopters. Violet and yellow were commonly used to mark pick-up zones or the RT's location when supporting gunships arrived. Green was seldom used being difficult to spot in the vividly green jungle. AN-M8 white smoke grenades (pale green body, yellow band) were used for screening when breaking contact. It required 10–20 seconds to develop an effective screen. RTs had to be careful when “popping” white smoke as helicopters marked targets with white phosphorus rockets and a cloud of white smoke might be fired on. Any color of smoke caused disorientation to pursuers at night. An AN-M14 thermite incendiary grenade (red body) was carried for each radio in the event it had to be destroyed. They could also be thrown at night to illuminate an area 200m (220yd) in radius or start brush fires as an RT withdrew under pursuit. M7A2 tear-gas grenades (gray body, red band) discouraged pursuing enemy as they seldom possessed gasmasks. Tear gas could panic even experienced troops. One technique, about to be deployed here by the man on the left, was to pre-wire a white smoke and a tear-gas grenade together, secure them to a 15–20ft parachute suspension line (“550 cord”), ignite both grenades, and run while dragging it behind the team. M34 white phosphorus grenades (pale green body, yellow band, “fragment” segmentations) created an immediate smoke screen and threw gobs of burning WP up to 20m (22yd) to strongly discourage pursuit. They were difficult to throw sufficiently far within dense vegetation. On the ground is a Chinese Type 67 stick grenade, which frequently resulted in duds. In the 1930s it was copied in Manchuria by the Japanese as the Type 98 (1938).

US Army troops in Vietnam, 1964. The man to the left and the other in the upper left carry universal M14 rifle magazine pouches. On both sides were loops (for arming levers) and snap-straps for carrying M26 hand grenades. The same pouches would later accommodate M16 rifle magazines and M67 grenades. Two grenades could also be carried inside the pouches in lieu of magazines. (US Army)



heavy, standard operating procedures often specified that every man was to fire up to five magazines while the grenadier rapid-fired his 40mm grenade launcher. The goal was to gain fire superiority and keep the enemy's heads down as the team disengaged. For a flank engagement, the team turned in that direction and opened fire. On order the team conducted a "peel-back." The pointman emptied his magazine, threw a grenade, and ran to the rear while reloading, as the second man emptied a magazine and threw a grenade. One of these grenades may have been a WP to blind and panic the enemy. Odd-numbered men stepped to the right and even-numbered to the left to leave a "lane" down the formation's center. Some men might grenade to the flanks to discourage outflanking attempts. Each man would peel-back after firing and take up a position to the rear on-line to mass the defenders' fire or repeat another peel-back. This would continue until the leader ordered them to run for it and smoke grenades were popped to hamper the enemy in finding their trail. A Claymore mine or grenades with 1-minute delay fuses might be set on the back-trail, as well as trip-wired grenades. The pointman and tail-gunner usually carried pre-rigged Claymores or grenades.

OTHER USES FOR GRENADES

Grenades as booby traps

Owing to their design, size, and pull-type arming pins, most grenades are adaptable to booby traps.³ The commonest means of activating booby traps is by tripwire. One method is to securely fasten a grenade to a stake or tree across a path or building entry, and attach one end of a tripwire to the arming pin and the other to a solid object. A pull on the tripwire will pull the grenade's pin to detonate after the normal delay. The tripwire can also be fastened to a limb hanging across a trail to detonate when pushed out of the way. A second method is to fasten a tin can horizontally to a tree. A tripwire is attached to the grenade so as not to interfere with the arming lever, the grenade is inserted in the container with the lever inside, and the pin pulled. When the wire is tugged the grenade is pulled out and the lever flies off. Another method is to remove the fuse assembly and replace it with a pull-release, tension-release, or pressure- (AKA push-) release mechanical firing device. Yet another method is to place a grenade under a discarded weapon, dead body, ration container, or desirable object. When the object is lifted off the grenade, which has its arming pin removed, the lever is released, and it detonates after its normal delay. Sometimes the delay train is removed to provide an instantaneously detonating booby trap. This cannot be easily done on many grenades.

During World War II, zero-delay grenades could also be left behind for enemy soldiers to recover and attempt to use. The British accused the Italians of deliberately leaving booby-trapped grenades on the battlefield,



This US M61 fragmentation grenade was manufactured in May 1969. The M26A1 and M61 were widely used in Vietnam and supplied to all Free World forces. They were also license-made by Australia (M26A1, M26A2 delay), Israel (M26 – their designation for the M26A1 – and M26A2 delay), Portugal (M312), South Africa (M26), UK (L2A1, L2A2), and West Germany (DM41 Splitterhandgranate; see above). Israel and South Africa use the M26 body on their MA/AP65 and M791 rifle grenades, respectively. US-made M26s were used by Brazil, Canada (M26, M26A1, M26A2 delay, M61), Chile, Colombia, Guatemala, Japan, Liberia, New Zealand, Nicaragua, Pakistan, South Korea, and Taiwan. To throw a clip-fitted grenade, it is gripped in the normal manner, the clip rotated to unlatch the lever – this can be done with the thumb of the hand gripping the grenade – the pin pulled, and the grenade thrown. The clip was removed from grenades used as booby traps so the enemy would not disarm it by simply re-latching it. A problem emerged, in that many soldiers trained on grenades without clips, but when issued clipped grenades in Vietnam failed to unlatch the clip. The enemy might find and return it. This occurred during a firefight the author was involved in, when a team member failed to unlatch a clip. We expected it to be returned, but it never was. (USAF)

³ See Osprey Elite 100 *World War II Axis Booby Traps and Sabotage Tactics* and Elite 184 *World War II Allied Sabotage Devices and Booby Traps*.

A British Royal Marine throws an L83A1 training white smoke grenade in Afghanistan to screen his section. "Training smoke grenades" do not include zinc in their compound owing to its toxicity. They do not create as dense a smoke screen. The US M83 white smoke grenade serves the same purpose. Even so, they are sometimes used in combat. Note the horizontal web loops on his harness to carry hand grenades by their arming handles as well as attaching different carrying pouches. (Photo: Cpl Barry Lloyd RLC/MOD)



but they were mostly duds. Grenades as booby traps were often incorporated into obstacles to hamper their breaching or removal. Booby-trapped grenades were also placed on avenues of approach to delay the enemy and provide warning of his approach. Smoke and incendiary grenades could be used for warning. Booby traps could be used to hamper intelligence personnel and others attempting to recover abandoned equipment. Booby-trapping landmines with grenades was widespread.

OPPOSITE The British No. 75 Mk II "Hawkins" mine-grenade could be used as an AT landmine, AT grenade, or demolition charge. The pressure or striker plate on the top is shown in cutaway here to reveal the igniter holders, which when crushed by a vehicle detonated the mine. The tube-like igniters are not shown. A method used to blast an entry opening through a building's wall was the "mouse-holing charge." This was a wooden frame measuring 1×2ft and held against a wall by a slanted plank. Hawkins mines were fastened to each corner. A length of detonating cord was attached to each and linked in the center to a detonator fired by safety fuse. Three or more Hawkins could be fastened to the end of a pole and with only one primed with a delay fuse, used to attack fortifications as a pole charge. The US M7 light AT mine-grenade was developed from the "Hawkins" in 1943. (US Navy)

Grenades as AT weapons

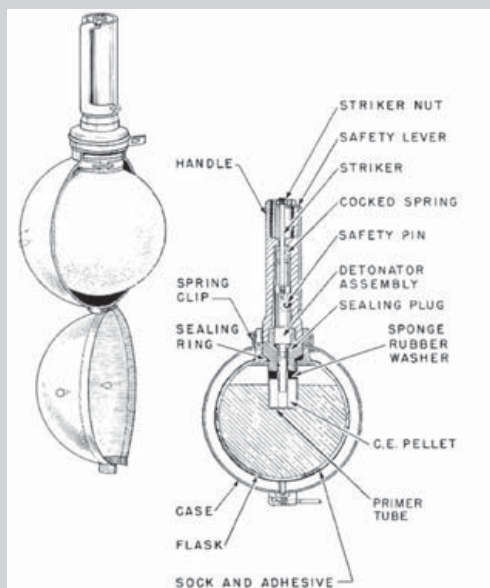
When dedicated AT weapons were not available, antipersonnel hand grenades were used instead against enemy armor by enterprising – or desperate – troops. Captain Nick Hallett recalled the desperate fight for Le Paradis, France, in May 1940:

The forward [British] section came in [to the village being defended], leaving their guns, and worse, their AT rifles. And for a bit there was ... chaos ... Eventually we had a brainwave, and ran out below the tanks' angle of fire, and put Mills grenades in the tracks. It did not do the tanks much harm, but [it] frightened the drivers, and they ditched them. We got four that way ... (Quoted in Sebag-Montefiore 2007: 286)

Britain fielded several unusual AT grenades between 1940 and 1943 relying on blast rather than shaped charges. They are addressed here as they were also used in antipersonnel roles. Introduced in June 1942, the No. 75 antitank grenade-mine or "Hawkins grenade" was actually a small landmine. This versatile munition could be buried as a landmine, thrown as an AT grenade, or used as a demolition charge. The Hawkins was fabricated from 1.2-pint cans measuring 6.55×3.75×2.25in. The exploders

The most dangerous-to-use hand grenade

The British **No. 74 Mk II** AT grenade, better known as the “**sticky bomb**” or “**ST**” (sticky-type), was quite unpopular. It was developed in early 1940 as a sabotage weapon by the War Office’s Directorate of Military Intelligence. The “ST” was offered to the Army, but considered too dangerous. Even so, they were soon issued to the Home Guard and Army, desperate for AT weapons. To use the No. 74 Mk II, a cover-retaining pin, near the handle, was pulled and the hemispheres opened and fell off – or might have to be shaken – while the grenade was held downward. The safety pin in the handle was then pulled while the arming lever was held against the handle. A warning tag was attached to the safety pin, reading “DANGER DO NOT REMOVE THIS PIN UNTIL READY TO THROW GRENADE.” The grenade was thrown and the arming lever flew off and ignited the 5-second fuse. The grenade stuck to the side of the tank, or anything else such as the bomb thrower’s uniform, and detonated relying on blast effect. It would not stick to a vertical or sloping surface if wet, muddy, or oily. Weighing 2.25lb, it could be thrown about 20yd or hand-emplaced to a firing port cover or pillbox door. If hand-emplaced it was smashed against the target with enough force to break the flask and the soldier had to withdraw at least 10yd before it detonated – another reason for its unpopularity. The “ST” saw little action with the British, but it was provided to the French Resistance. Australian troops in New Guinea found that it performed very poorly, quickly losing its stickiness in the tropics. It was withdrawn in 1943 due to deteriorating nitroglycerin and the glue drying out in storage.



The “ST” consisted of a 4.5in-diameter, two-piece, hinged, stamped-steel sphere. Inside was a stockinet stretchy cloth-covered spherical Bakelite flask filled with 20oz of Nobel’s 823 (nitrocellulose and nitroglycerin). An air space was left in the flask to allow the explosive to expand in hot weather. A retaining clip held the cover to the flask’s neck. The stockinet cover was thickly coated with especially sticky lime glue made from bird droppings. Two rubber projections in each half of the cover kept the sticky covering from coming in contact with the inside of the cover. The flask had a collar in which the handle-like delay fuse was fitted – the overall length was 9.5in. This also held the detonator inside the flask. (US Navy)

were under a metal pressure plate that when crushed by at least 300lb, the mine’s 18oz of Nobel’s 704B or ammonal or Burrowite (Mk I and Mk II), or TNT (Mk III), detonated. They could be thrown in front of vehicles, placed on a road, strung together at 2ft intervals (“necklaces”) and pulled across an approaching vehicle’s path, or placed under the front and rear end of a parked tank’s treads to detonate when it moved. When thrown on the ground they could land with the pressure plate up or down. Either way, a vehicle’s weight detonated them. They could be placed under railroad ties as a pressure mine or fastened to a rail with a delay fuse to cut it. Several could be linked with four wraps of detonating cord to destroy a section of track. As a grenade or demolition charge, a friction igniter, a length of safety fuse, and a detonator was inserted in one of the

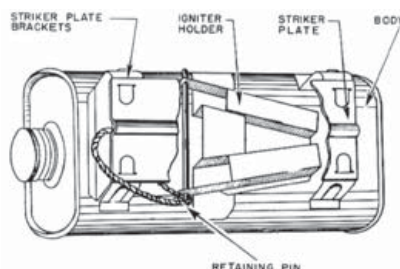
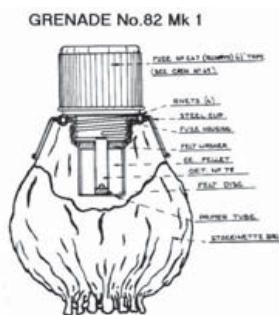


Figure 242—A.T. Hand Grenade No. 73 Mk II



The British No. 82 Mk I "Gammon Bomb" was provided with a black stockinet bag that could be filled with up to 0.9kg (1.98lb) of plastic explosives as required for the mission, be it antitank, antibunker, or antipersonnel. A smaller quantity of PE might be used for knocking out a machine-gun nest. On some occasions, when used against personnel, gravel, nails, or scrap metal were pressed into the half-charge of PE before inserting it in the bag. It used the No. 247 "all-ways" impact-detonating fuse. The No. 82 Mk I was also used by the US Airborne in Normandy and by the French Resistance. The Gammon Bomb was declared obsolete in 1954. It can be identified by its black bag, buff collar, all-black cap (11.5in top) or black cap with red top (4.5in top). (US Army)

exploder holders. A Hawkins grenade was to be thrown onto a tank's engine deck or in its tracks. One or two charges could break a tank track or destroy a soft-skin vehicle's wheel. The little used late-war Mk III mine was similar to the Mk II, but was filled with TNT. Besides use by the British Army, the US Airborne and French Resistance used the Hawkins. The No. 75 was declared obsolete in 1955. It can be identified by its service-brown or buff body, red "filled" band, pink cap if filled with ammonal or Burrowite, and black markings.

The No. 82 AT grenade or “**Gammon Bomb**” was developed by Captain Richard S. Gammon of 1st Battalion, The Parachute Regiment in 1941. The Mk I was adopted in May 1943 and the Mk II in September 1944. They consisted of an impact-fuse assembly and collar riveted to a stockinet bag, open on the bottom with elastic in the hem. A varied amount of plastic explosive as required for the task was pressed into a ball and placed in the stockinet bag. As an AT grenade a large amount was required as it relied on blast effect. The difference between the two marks was that the Mk II’s bag was made of rot-resistant material. The No. 82 used the same all-ways fuse as the No. 69 offensive grenade. Early versions had a 4.5in-long arming tape rather than the later 11.5in-long tape, adopted because of the danger posed by the short tape if the grenade was thrown at too short a range from the target.

The Soviets also made wide use of AT hand grenades (*Ruchnaya Protibotankovyi Granata – RPG*) during World War II. All were OD with black markings. The **RPG-40** was a heavy AT blast-type stick grenade required to be thrown at very close ranges from a protected position owing to its blast and secondary fragmentation. Weighing 1.11kg (2.45lb) and measuring 200mm (7.87in) long and 95mm (3.74in) in diameter, it was only marginally effective, with a 20–25mm (0.79–0.98in) penetration, and was more effective as an antipersonnel blast grenade – except for its short throwing range. While soon supplanted by the RPG-43 and later the RPG-6, both shaped-charge weapons, the RPG-40 remained in service for antipersonnel and anti-bunker use.

AT hand grenades have all but disappeared since World War II. The United States, for example, never adopted an AT hand grenade. They are relatively ineffective against modern armored fighting vehicles, even light armor. The much more efficient single-shot, throwaway, shoulder-fired AT rocket launchers are much more effective than any type of AT hand or rifle grenade. One of the few post-World War II AT grenades was the **RKG-3** (Ruchnaya Kumulyativnaya Granata-3). It was used through the Cold War and is still found in use. Fielded in 1950, it was replaced by the RPG-18 disposable AT rocket launcher in 1972, but has remained in use worldwide, seeing combat in Vietnam, the Arab–Israeli conflict, Iraq, and Afghanistan. China’s simplified version was the Type 3. Two subsequent versions offer improved penetration over the original’s 150mm (5.91in), the RKG-3E (170mm, or 6.69in) and the RKG-3EM (220mm, or 8.66in). The all-metal grenade contains a small stability drogue in its throwing handle to ensure it impact-detonates at the necessary aspect. Throwing range is 15–20m (16–22yd); the author threw some in Vietnam and found they penetrated almost 6ft in hard soil.



Improvised grenades

Many countries, especially those *in extremis*, have employed expedient or improvised grenades to make up for shortages or supplement standard grenades. Partisans and guerrillas have also fabricated their own grenades. Expedient grenades were made by the troops of both sides during the Russo-Japanese War. With inadequate grenade stocks in the first months of World War I, all sides produced “trench grenades,” either in the front-line trenches or in unit ordnance shops and depots. The quality and variety was astonishing, ranging from jam tins full of gun cotton and nails with a safety fuse, to workshop metal-bodied grenades with friction igniters. A common type used by all sides was the “hairbrush” or “racket” grenade, a paddle-shaped piece of wood with a demolition block wired to the paddle end and a time fuse running the length of the hand with a friction igniter. Such grenades may also have been made by placing explosives or incendiary agents in suitable containers (cans, bottles, pottery jars, pipes, bamboo tubes, large-caliber cartridge cases, etc.) and attaching a simple time-delay fuse with a blasting cap. These may also have been fabricated by modifying other munitions such as small demolition charges and mortar rounds. Usually, a standard grenade fuse or burning-type safety fuse, often with a pull-type fuse igniter, was attached.

During World War II the Germans made numerous grenades with concrete bodies with a cavity accepting a small cylindrical demolition charge. The Germans also made stick grenades with a wooden handle and head, again bored to take a demolition charge. Such devices were sometimes unreliable, made of non-durable materials, and were poorly weather-sealed. They had to be handled with extreme caution and were generally considered only marginally safe to the user, even when new.

A US Army collection of grenades used by the Viet Cong during the Vietnam War. Note they are drilled with holes and bear embossing tape labels marked EMPTY. The top row are mainly “jungle factory” made using food and drink cans. The second and third rows include Soviet, French, and Japanese grenades among others, often “rebuilt” and modified with homemade, Soviet/Chinese, or American fuses. All were crude and as dangerous to the throwers as they were to the intended victims. (Tom Laemlein/Armor Plate Press)



IMPACT

Assessing the hand grenade's influence

BATTLEFIELD IMPACT

Grenade effects

The violent explosion of a grenade creates smoke and dust, with a modest flash in daylight; at night a more significant flash may dazzle those nearby. Most grenades cause casualties (dead and wounded) by blast and fragmentation. Blast can cause severe injuries. It is much reduced in the open, but within enclosures blast is greatly magnified. Blast can be reflected from hard surfaces and is more pronounced in such circumstances than in a muddy field. Injuries resulting from blast overpressure include concussion and shock, while explosive flash can result in lacerations, dismemberment, internal injuries, eye and ear damage, and burns.

Fragmentation is the real casualty producer, however. When detonated, a grenade's body produces dozens to hundreds of fragments – AKA splinters or shrapnel. (The latter term is technically incorrect, but commonly used. Invented by a Royal Artillery officer, Henry Shrapnel, in 1784, shrapnel was an artillery projectile filled with a bursting charge and lead balls (shrapnel); it was designed to burst in the air to shower troops from above.) The more fragments produced the greater the number of casualties, and casualties are more severe owing to multiple wounds. Fragment size is important – too small and they may inflict only minor wounds. Explosives with an extremely high brisance can shatter the grenade's body to such an extent that some fragments will be no larger than grains of sand. Small fragments may not have sufficient mass and velocity (3,000ft/sec and greater) to pierce thick clothing or penetrate a human body deeply enough to damage organs. Large fragments can travel

OPPOSITE US Marines, sheltered by a purpose-built concrete grenade-throwing pit, are pictured during training in the M67 grenade at Camp Lemonnier, Djibouti, in January 2008. Note the mid-air separation of the safety spoon from the rest of the grenade. Grenade explosions are not the massive, gasoline-enhanced fireballs often depicted in movies. Also, in contrast to Hollywood portrayals, a single grenade will seldom blow off a tank tread, lift a car off the road, disintegrate a building, or blast gaps through barbed wire. (US Navy)



too far, however, and endanger exposed friendly troops. Fragments weighing at least 0.15g (2.3 grains) and measuring at least 3mm (0.12in) in diameter are considered the minimum to inflict incapacitating wounds. Multiple wounds from small fragments are generally necessary to incapacitate the target. As an example, the US M26/British L2 frag has a fragmentation pattern of 3.7 fragments per square meter (1.2sq yd) at 5m (5.47yd) and only 0.9 fragments per square meter at 10m (10.94yd). The fragments struck with an energy of about 86J (63.43ft lb) at 5m – sufficient force to penetrate thick clothing and deeply enough into the body to damage organs.

Casualty radius is subject to much variance. The criteria for determining the number of casualties produced within a given radius varies by country and errs on the high side. Casualty radius is usually defined as a radius from the point of detonation in which at least 50 percent of standing personnel are killed or incapacitated. At least a quarter of a grenade's fragments are absorbed into the ground and others go straight up. Deep mud or snow can "smother" some of a grenade's effects. Dense vegetation can "dampen" blast and fragmentation. Of course, when it is stated that a grenade's casualty radius is 5m (5.47yd), that does not mean there were no casualties outside of that. A grenade bursting over the heads of troops would cause more casualties in a wider radius than on the ground. Results in the field usually do not replicate test-center statistics. Secondary fragmentation (gravel, rocks, masonry, wood splinters, glass, etc.) propelled by the blast also causes injuries.

Fragmentation and blast effects are not consistent in a 360-degree radius. Most grenades were oval- or can-shaped and fragmentation generated from the ends was less than from the sides, resulting in uneven patterns. Two extreme examples are found in Stephen Ambrose's *Band of Brothers* describing the effects of German Stg 24 stick grenades. The first event occurred in Normandy:

A German potato masher sailed into the trench; everyone dived to the ground. "Joe, look out!" Winters called to Toye. The grenade had landed between his legs as he lay face down. Toye flipped over. The potato masher hit his rifle and tore up the stock as it exploded, but he was uninjured. "If it wasn't for Winters," Toye said in 1990, "I'd be singing high soprano today." (Ambrose 2002: 97–98)

The second event took place in the Netherlands: "Other Germans pitched grenades of their own over the dyke. Alley got blown to the ground by a blast of shrapnel that left thirty-two wounds in his left side, face, neck, and arm" (Ambrose 2002: 189).

It is extremely difficult to make a meaningful comparison between grenades and other types of weapon in terms of their ability to inflict casualties. Grenades are essentially HE-delivering "micro weapons," that is, while destructive to point targets, they are not widely destructive like artillery and mortar barrages. In World War I, the British Army recorded that 2.19 percent of its casualties were caused by grenades as opposed to 58.51 percent caused by shells and mortar bombs. In the equivalent



Before deploying to South Korea, US Marines practice building clearing with a practice grenade in a mock Korean village at California's Camp Pendleton in 1953. The reality is that an actual detonating fragmentation grenade would kill or wound all three men owing to large fragments penetrating the light wooden wall. Structures with thin wooden or thatch walls will not stop grenade fragments. Clearing a room by tossing in a grenade and sheltering outside behind thin walls results in friendly casualties. The use of blast (offensive) grenades reduces this possibility. While all armies, until recent years, have taught soldiers to fire shoulder weapons right-handed regardless of their dominating arm, it was recognized that forcing a left-handed soldier to throw right-handed was ineffective and dangerous. Left-handed throwers typically grip a grenade upside-down so the arming pin is on the opposite side of the fuse as it would be when held right-handed, allowing it to be pulled with the opposing (right) hand. (Tom Laemlein/Armor Plate Press)

statistics for World War II, grenades were included in a much larger category also covering mortar bombs, aerial bombs, and artillery shells; 75 percent of casualties were attributed to this larger category, with a further 15 percent being attributed to blast, crush, phosphorus and other miscellaneous causes (Holmes 2004: 210). During World War II the US Army suffered 0.5 percent dead and 2.5 percent wounded to grenades. A further 0.2 percent were killed and 0.5 percent wounded by booby traps, many of which were made from grenades. The ratio is small when compared to over 50 percent killed by artillery and over 30 percent by small arms. Determining the numbers of casualties caused by grenades is difficult owing to poor record-keeping in the field and recording wounds only as “fragmentation” (which could be caused by many munitions). Casualties listed as caused by “booby traps” *may* have been from grenades too. In Vietnam the United States lost 4,100 men to grenades *and* mines. Additionally, almost 7,400 were lost to “multiple fragmentation wounds,” which no doubt included grenades. To the infantryman in the line, however, grenades provided an invaluable extra dimension to the damage he could inflict in the immediate combat range of action that concerns the soldier – approximately 50yd – much more so than the rifle and bayonet.

Defense against grenades

For troops in the attack the best defense against grenades is to keep moving and avoid being pinned down within grenade range. Of course, enemy fire and obstacles can hamper a unit's movements. If receiving grenade barrages and other enemy fire and obstacles permit, the attacking unit should move out of the area. Grenade battles – what the Germans called a *Schneeballschlacht* (snowball fight) – should be avoided. If in the open and grenades land nearby, troops should hug the ground with the helmet toward the grenade and protect the face with the arms.

World War I-era German grenadiers practice throwing stick grenades steep and high to overcome a barrier. Note the practice grenades hung in the wire mesh thrown at them by other practicing grenadiers. They practice throwing with their rifles slung, as they would be in combat. This type of barrier was erected in front of trenches prone to enemy trench raids and grenade attacks. (Tom Laemlein/Armor Plate Press)



There are more options in the defense, time and materials permitting. The parapet of a foxhole or trench may prevent grenades from being tumbled into the position. The parapet protects soldiers firing forward if grenades land behind the position. During World War I the front edge of trenches were squared rather than sloped to help deflect grenades. The Germans learned to dig narrow trenches, making them harder to grenade. Wire mesh could be erected in front of vulnerable trench sections and sloped inward. This mesh had to be high enough that a grenade thrown over it would land behind the trench. Exposed trench sections with a probability of being captured had a 1ft mesh of wire over them; if captured, the mesh could be bombed out as it did not deflect grenades, but prevented occupiers from throwing grenades.

Mesh can be placed over firing ports or windows to deflect grenades. This of course could be shot out by an automatic weapon, but it will protect from grenades during the initial assault. If a firing port is at ground level, a small pit can be dug in front of it to catch rolling grenades and prevent debris from artillery from blocking the port. Mesh, bed frames, mattresses, or boards can block windows. Building defenders expecting attackers to grenade rooms can erect a hasty “corner barricade” in a corner out of sight from the door. This would be built of furniture and mattresses – anything to stop fragments. Once the grenade detonated the defenders would fire on anyone entering the room from the door’s blind side. During World War II US and Japanese troops sometimes dug grenade sumps in foxhole and pillbox bottoms into which grenades could be kicked.

During World War I bombing posts were prepared behind forward trenches from which grenadiers could bomb out the captured trench. Bombing posts were also prepared to cover sections of front-line trench to block attackers moving down the trenches. Sandbags and timbers were stockpiled to build barricades. The final protective wire – a barbed-wire barrier closest to the defensive position – is typically just outside of

grenade range of the positions to prevent the attackers from ranging them – 20–40m (22–44yd) – considering the enemy will be most likely throwing from the prone. Of course the enemy outside the wire will be beyond the defenders' grenade range. Instead, this is covered by grenade launchers and machine-gun and mortar final protective fires, plus booby-trapped grenades in the wire. Close-in dead spaces that cannot be covered by direct-fire weapons, approaches such as gullies and ditches, and dense concealing vegetation can be designated target areas and individuals assigned to grenade them. Grenades can be thrown short of the wire if the enemy begins crossing it.

A reality of grenades is the fact that the delay – typically 4–5 seconds – allows a quick and agile enemy to throw back a grenade, what the Germans called a *leih-Ei* (loaned egg). Clearly, this is risky as it is not known how much time remains. Of course, if the enemy combatant is unable to immediately exit the structure or foxhole when a grenade enters, there is little choice. Individuals attempting to return a grenade have lost hands, arms, and lives. Others have thrown themselves on grenades to protect comrades. Some even survive, although horribly wounded. Body armor, helmets, or even a rucksack have saved soldiers. This has occurred both in combat and in training accidents. In US service the Medal of Honor is awarded, while Britain presents either the Victoria Cross (posthumously) or George Cross (survived) and France the *Croix de guerre*. Soviet (and then Russian) soldiers are honored as a Hero of the Soviet Union (or Russian Federation); Israel awards the Medal of Courage, its second-highest valor medal, to those in combat, or the Medal of Distinguished Service to those involved in a training accident. Until 1945 Germany granted the Iron Cross, its grade depending on what earlier grades the recipient had received. During World War II, Japan had no such consideration for those sacrificing themselves for comrades. They sacrificed themselves for the Emperor, considered to be an honor in itself.

Extra precautions are necessary with dud grenades – “blinds” in British parlance, and *Blindgänger* in German – also termed a *Eunuch*, *Leisetreter* (“pussyfoot”), or *zahmer Tommy* (“Tamer Tommy” – a dud explosive munition). Typically, duds are caused by the primer or detonator failing, or the delay fuse failing to ignite. Percussion grenades with a firing pin may have jammed the pin and if disturbed might activate. Dud delay-fused grenades are especially dangerous. No dud grenade should ever be moved. If possible they should be marked and engineers or explosive ordnance disposal personnel will take care of them, usually with demolition charges – this is known as being “blown in place.”



At a 3rd Armored Division armored rifle company's ammunition distribution point, Mk IIA1 fragmentation grenades are ready for issue. Some have been packed in an M1932 musette bag. Among the frags is an M15 WP grenade. (Tom Laemlein/Armor Plate Press)

Constraints on grenade use

Especially in the early days of mass-produced grenades, inherent design flaws could make such weapons very dangerous to the user. One German infantry officer who fought on the Somme, Landwehr-Leutnant M. Gerster, recalled the steady improvement in the variety and quality of hand grenades during 1915:

The makeshift hand grenades available on the outbreak of war disappeared gradually. Factory-made types replaced them: the discus grenade, which gradually disappeared too; the ball-shaped grenade, later relieved by the lighter egg grenade, which could be thrown further and the stick grenade. The safety device of the stick grenade was a constant source of concern and anger for the company commanders. Despite all care, again and again the firing cord was accidentally caught and pulled on exiting dugouts, or when passing along trenches revetted with wooden hurdles. This ignited the grenade without the carrier being aware of the fact, thus putting him in mortal danger. The star screw catch, which was introduced after much experimentation, finally produced a splendid solution to a problem which was far from insignificant for the infantry. (Quoted in Sheldon 2007: 79)

Although some subsequent commentators have rated the World War I-era German stick and egg grenades more highly than the Mills Bomb in terms of throwing range, at the time both sides appear to have viewed the British grenade to be the superior weapon – not least owing to its lethal fragmentation effect. The Germans found they were hampered by the sheer length and size of the stick grenade, and by the lack of throwing skills among new recruits. In October 1916 one German officer reported that his men consisted “almost two-thirds of replacements, who had no acquaintance with hand grenades, and therefore did not stand a chance against the British, who are very well trained in this respect. Our few good grenade-throwers had been reassigned almost immediately, and we received nobody to take their place” (quoted in Duffy 2007: 281).

During the early days of mass-produced, mass-issue grenades, new types could arrive at the front too late to see widespread service. After a campaign that saw the widespread use of improvised grenades by both sides, the Allied evacuation of the foothold at Gallipoli in 1915–16 coincided with Mills Bombs finally appearing at the front:

... the officers took a last look along the line. A lieutenant ... heard the sound of bombs exploding. He found a lone Australian trying out the new Mills bomb grenades, which had only just arrived and were rationed because they cost the fabulous sum of 17 shillings and sixpence each. “It’s a pity not to use them,” the lone bomber explained, “they’re great.” (Quoted in Carlyon 2003: 634)

Untold millions of grenades have been expended in combat since World War I. Grenades were in constant demand. Units in the defense stockpiled grenades in forward positions, be they foxholes or defended buildings,



The US Army issued the three-pocket grenade carrier from late 1944. The carriers were safer, protected the arming pin from accidentally being snagged, provided mud and weather protection, made grenades easily accessible, and negated the need to tape pull rings or levers. These carriers were also used in Korea. The US Marine Corps issued a similar two-pocket carrier. (Tom Laemlein/Armor Plate Press)

and reserve stocks were held at each echelon: company, battalion, and regiment/brigade. Grenades would be stockpiled in fallback positions as well. Units in the attack typically required each man to carry 2–4 grenades; more were carried in bulk by reserve units, often in boxes, buckets, or sandbags. Resupply carrying parties also brought additional grenades forward. Such practices could make the carrier particularly vulnerable to enemy fire, as one German machine-gun officer, Reserve-Leutnant Borelli, recalled of his service on the Somme in July 1916:

My machine gun crews suffered heavy casualties because the British, who were sheltering in the craters directly to our front, could not be brought under fire and so were able to throw grenades with impunity ... Our shortages of grenades and flares made themselves felt and it was not until dawn that we could see the individual groups of British troops lying on the ground and seeking cover in the shell craters ... It seemed that the British carried large stocks of grenades on their waist

belts because we saw that often our bullets were causing explosions.
(Quoted in Sheldon 2007: 193–94)

Amid such shortages it was routine for troops to use captured grenades against their former owners. If not formally trained to use enemy grenades, units in combat quickly had to learn how to employ them safely. Even where grenades were available, hastily trained troops found them dangerous to use, as the Soviets found during the battle for Stalingrad in 1942–43:

Not surprisingly, there were many accidents caused by untrained soldiers. The second-in-command of a company was killed and several men were badly wounded when a newly arrived recruit mishandled a grenade. Others were killed when soldiers, mainly from Central Asia, tried to fit captured German detonators in their own grenades. “Further weapon training is needed,” the chief of the political department reported to the military council of Stalingrad Front. (Quoted in Beevor 1999: 153)

TECHNICAL IMPACT

The quest for range

Hand-grenade throwing range is limited by physical properties. Weight is of course a factor, but unlike other weapons’ capabilities – affected by propellant, projectile design, barrel length, etc. – the range of grenades is limited mostly by the thrower’s strength, agility, proficiency in throwing techniques, and even the clothing and equipment he wears. Grenades are close-range weapons and the average 30–40m (33–44yd) range was seen as sufficient in most cases. A strong and proficient thrower using a lighter grenade might achieve 50m (55yd). There are of course always circumstances in which more range is desired. This led to rifle grenades being developed at the turn of the century, at the same time hand grenades were recognized as still of value.

The first type of rifle grenade involved a **cup discharger** being fitted to a rifle’s muzzle. The grenade, often a modified hand grenade, was inserted in the cup and launched using bulletless cartridges with a special propellant charge. It is important to note that grenade-launcher cartridges were not technically “blank” cartridges as so often reported. Some countries used launcher cartridges with solid or hollow soft-wood bullets that shattered when fired. These were not substitutes for metallic bullets intended to be fired at personnel as is sometimes rumored. Another type was the **spigot launcher**, involving a tube being attached to the rifle’s muzzle and the use of grenades fitted with a tailboom. The tailboom, which included stabilizing fins, was slid onto the launcher tube. This allowed the range to be adjusted, up to a point. The farther down the tube the tailboom was slid, the longer the range. Rifle grenades could be fired horizontally to provide direct fire, or indirectly, with the rifle’s butt planted on the ground and angled upward. Some were provided with special sights to set the elevation, but often this

was simply estimated. They were not generally accurate weapons. Their range was typically 75–150m (82–165yd) for indirect fire. For direct fire, used against armored vehicles, pillboxes, or crew-served weapons positions, they were seldom effective beyond 100m (110yd).

Rifle grenades supplemented hand grenades, filled the range gap between hand grenades and light (50–60mm) mortars at company level, and also, at the beginning of World War II, served as barely adequate AT weapons. In the opening years of that conflict, the first munitions developed by most armies bearing the new AT shaped charge were rifle grenades. These soon became obsolescent against tanks, but were still effective against light armor and hardened structures. Rifle grenades also included antipersonnel (HE/frag), screening and marking smoke, illumination, signal flares, and tear gas models. Many countries developed **grenade projectors** – light, simple mortars – on the eve of World War II to replace or supplement rifle grenade launchers at platoon level. Some could provide direct fire, not just indirect fire. Although a few countries retained weapons of this type in the post-war years, they mostly fell from use by the end of World War II as their small projectiles were insufficiently potent – not much more powerful than a hand grenade – and were too heavy and short-ranged. Rifle grenades, too, were largely phased out by the 1970s, being replaced by under-barrel 40mm grenade launchers (UGL) as well as by single-shot, throwaway, shoulder-fired AT rocket launchers. The 40mm UGL was pioneered by the United States, with the M79 and M203 developed during the 1960s eventually leading other countries to produce them.

Other types of hand grenade

There are few truly new types of grenades. HE/fragmentation grenades remain the mostly widely used type, being true multipurpose weapons. Pure blast grenades – that is, grenades with thin, light, limited fragmenting bodies – have all but fallen from use. Many modern HE/fragmentation grenades have smooth bodies of thin materials, even plastic bodies, and it is often assumed that since they lack “fragmentation” segmentations that they are blast grenades when in fact they contain efficient fragmentation liners. The idea of impact-detonated grenade fuses occasionally reemerges, but as before, they are largely rejected by the troops owing to their inherent dangers.

Colored **smoke grenades** are still very much in use. Hazardous pyrotechnic mixtures, especially zinc and sulfur, are being replaced by safer materials, and denser, more vivid, and longer-duration smoke compounds are under development. With all the turmoil found in the world since World War II, it is no wonder that **riot-control** or **tear-gas grenades** have come into



Three *äusserst Feldgrau* (“extremely field gray,” i.e., very experienced) front-line German soldiers on the Eastern Front show two of the commonest means of carrying hand grenades. An Stg 24 stick grenade is stuck in the belt of the left man and an Eihgr 39 egg grenade is suspended by a carrying ring on its bottom fastened to a cartridge pouch’s securing strap on the right man. Stick grenades in the belt were easily accessible for throwing, but made it difficult to run at a low crouch or during a low crawl. Also, grenades were easily lost when crawling, and the fuses could be jammed with mud, dirt, snow, or vegetation debris. (Courtesy of Concord Publications)

wide use. Usually can-shaped, such grenades contain densely packed CS powder, virtually the worldwide standard for tear gas. They are not limited to only the armed forces, being used by law-enforcement and internal-security forces as well. Burning tear-gas grenades become extremely hot, making it hazardous for protesters to pick them up and throw them back. Riot-control grenades used by law-enforcement agencies are developed and produced by commercial enterprises and can be quite innovative. One example is the US Federal Laboratories **Model 515** triple-chaser tear-gas grenade. After impacting it breaks into three sections, with each bouncing in different directions to skitter about; this makes them almost impossible to throw back and spreads CS over a larger area. The same firm also produces a burning type CS grenade that additionally generates dense white smoke to further confuse and disorientate rioters. Extremely dense burning-type smoke grenades are also available to blind rioters. Another type of riot-control grenade is the bursting type. These are spherical grenades with frangible plastic bodies, thrown to airburst over the heads of rioters and quickly saturate a large crowd. An example of this type is the US **M25A2** with a baseball-sized bursting frangible body. Another is the softball-sized **XM47E3** with a rubber body. It is rubber so that when thrown into a crowd it is less likely to injure a person. They spew CS through a small port and spin the grenade erratically on the ground.

German ammunition point, Eastern Front 1943 (opposite)

As with all armies the Germans found grenade expenditure to be much heavier than anticipated during World War II. Their own production could not keep up and they readily made use of captured and impounded grenades. Here an *Obergrenadier*, an assistant squad leader of a rifle squad (*Schützengruppe*), collects the day's allotment of German- and Soviet-made grenades from the company ammunition supply point (*Munitionsausgabestelle*), dealt out by the *Feuerwerker* (armorer NCO), an *Unterfeldwebel*. The *Obergrenadier* wears the carrying pouches for rifle grenades (*Tragetaschen für Gewehrgranaten*). Each of the two bags held four stick grenades or several rifle grenades or other types of grenades. They were also locally made using a pair of sandbags with scrap webbing and rope. Stick grenades were also carried on the person in jackboot tops, belt, tunic front, or strapped to entrenching-tool carriers. In the foreground feet is a cluster charge (*Geballte Ladung*) made up of six Soviet RG-42 grenades with the fuses removed and wired around a Stg 24 stick grenade. Although this arrangement was meant to employ stick-grenade heads with the handles removed, it was common to use captured grenades instead. The cluster charge was intended to be thrown into tank treads or pillbox firing-ports for considerable

blast and fragmentation. Similarly, two stick or egg grenades could be wired or taped together, one ignited, and thrown into rooms or pillboxes to provide more devastating blast and fragmentation effects – as a double grenade (*Doppel-Granate*) or doorknocker (*Türklopfen*) – not shown. The *Feuerwerker* divided up the daily allowance of grenades allotted by battalion and then divided them up between the company's nine squads – leading him to be called the *Waffengott* ("weapons god"). Today's allotment is comprised of: Stg 24 stick grenades (five fragmentation sleeves were issued in each case); a few of the Nb Hgr 39, appearing similar to the Stg 24, but with a white band, and burning for 100–120 seconds; some Eihgr 39 nA grenades, temporarily suspended by their rings from the securing straps of the *Obergrenadier's* cartridge pouches; and a couple of Soviet RGD-33 Dyakonov hand grenades with fragmentation sleeves. Also issued is a carton of four Blendkörper 2H ("blinding smoke pots 2H"), one of which he is examining. It released dense white smoke when shattered against a tank and the titanium tetrachloride (FM) filler came into contact with air. It generated smoke for 15–20 seconds; intended to blind tank crews, the strong acidic smoke could be drawn into the tank to drive out the crew. Both steel and wooden grenade containers were to be returned through the supply system for reuse.

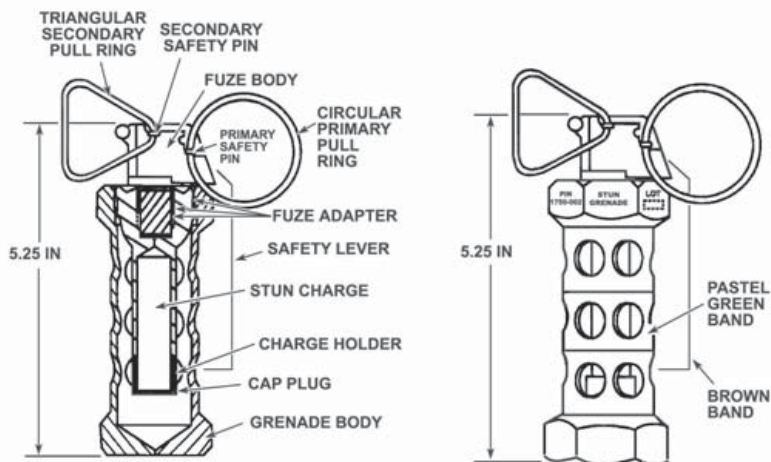


The most recent addition to the irritant chemical grenade family is an Indian-made crowd-control grenade introduced in 2010. It is packed with finely ground seeds of the *bhut jolokia* chili pepper (AKA ghost pepper), declared by the Guinness Book of World Records to be the hottest pepper in the world. The weaponized *bhut jolokia* measures 855,000–1,050,000 units on the Scoville scale, twice as hot as the next fieriest pepper, the Mexican red *savina habanero* pepper at 350,000–1,050,000. When the grenade bursts it spreads a non-toxic mist that burns the eyes, nostrils, and mouth so severely it causes temporary blindness, airway irritation, and breathing difficulties. The idea came from the pepper's longtime use to ward off rogue elephants. Peppers were burned in fires and the vapor drifted in the smoke – downwind from the elephant-harassed village.

Stun or flash-bang grenades are mainly employed for counterterrorist operations, especially when hostages are involved. Police also use them in hostage situations and they can be used for riot control. They should not be used around children or the elderly, but in dire situations they might have to be resorted to. They also have application in military operations, again, especially where civilians are involved such as during urban combat. The use of stun, burning-type riot control, and smoke grenades in violent civil disturbances, must be employed with caution. They can ignite flammable materials, create panic among rioters – causing a confused situation to get completely out of control – and affect the elderly, children, and those with respiratory problems. Smoke and tear gas displaces oxygen in confined enclosures and can lead to suffocation.

A newer type of riot-control grenade is the **sting grenade**, such as the US commercially produced Combined Tactical Systems **Model 9590** sting-ball grenade. This is a spherical, rubber-bodied grenade containing 105 .31-cal hard plastic balls. The grenade airbursts, showering the pellets on the crowd and separating the fuse assembly from the body. After a brief delay, the fuse body detonates with a brilliant and loud flash-bang charge. They can also contain tear-gas powder mixed with the plastic pellets. The pellets are quite painful, even when wearing medium-weight clothing.

Adopted in 1995, the US M84 stun grenade creates an extremely loud 170–180dB at 5ft, louder than a shotgun muzzle blast or space shuttle launch (an ambulance siren or jet engine is 120dB and a rock concert is 100dB and up). Noise pain threshold is 120dB and permanent ear damage is caused at 140dB collected simultaneously with a 6–8 million candela flash. Double-hearing protection – insert-type hearing protectors plus earmuff-type hearing protectors – is recommended for friendly personnel in the vicinity. The M84 is reported to effectively stun and disorientate individuals within 5–9m (5–10yd). The M84 weighs 8.33oz, is 5.25in high, and 1.73in in diameter. The M201A1 fuse has a delay of 1–2.3 seconds. The 0.16oz charge is a magnesium/ammonium nitrate pyrotechnic mixture. While its shape is unique, the M84 is identified by OD body (early ones had a back body) with a light-green band. It has double arming rings for surer safety; the circular one is pulled first, then the triangular. (Public Domain)





CONCLUSION

The modern hand grenade is actually little different from its precursors. Antipersonnel HE/fragmentation hand grenades have changed little in the last 20–30 years. Explosive fillers have been made more powerful, more stable, more resistant to climate, and less prone to premature detonation by fragments and bullets. Even more importantly, fuse systems are safer and more reliable and reveal no signature when activated – no pop, spark, or smoke. Body materials and designs create more fragmentation or use controlled fragmentation in the form of thousands of small steel balls, making them safer for friendly troops and deadlier to the enemy. Little can be done to improve grenades further. There are no cost-effective, more powerful explosives on the horizon, nor do grenades need to be any more powerful than they are, as this would endanger the user. Granted, a more powerful explosive means a smaller explosive charge to reduce weight and cost, but then a smaller grenade generates fewer fragments. About the only significant, across-the-board improvement has been the provision of more reliable and accurate time-delay elements, but of course there is always room for further development in safe and precise time-delay train elements. Little can be accomplished with respect to safety features – arming pins, arming levers, and safety clips.

Even so, efforts to develop innovations will of course continue. In 1997, Spain introduced the world's first electronically fused grenade. The Alhambra grenade is activated by an arming pin and uses an arming lever in the same way as conventionally fused grenades, but the instant the lever is released, an electric generator is activated and mechanically places the detonator in line with the firing train. An electronic safety delay prevents detonation for 4 seconds. This technology is innovative, but probably more expensive and more complex than existing methods. Development will no doubt continue on the relatively new stun grenades, and efforts are under way to make smoke grenades less toxic and burn in denser and more vivid colors.

A female Israeli soldier throws a dummy US M26 hand grenade. This demonstrates how a combat harness and a slung weapon – in this case a Colt 653, or *Mekut'zar* – can hinder grenade throwing, affecting both range and accuracy. Contrary to popular misconception, female soldiers do not serve in Israeli infantry, armor, and artillery units. Selected women undergo combat training as here, but serve as instructors in training units to relieve men for combat duty. (Israel Defense Forces)



The most telling features of the grenade is its characteristic simplicity. Compare a 300-year-old musket to a modern assault rifle and the differences are vast. A 300-year-old, black-powder-filled, pig-iron grenade with a pull-type friction igniter is actually little different in function and use from today's hand grenade. Regardless of advances in future small arms and other infantry weapons, 100 years from now infantrymen will probably be throwing hand grenades little different from those in use today.

GLOSSARY

ANTITANK GRENADE	Grenade with a shaped charge or heavy blast capable of penetrating light armor, concrete, and timber.
ARMING LEVER	A metal handle that is held in place by hand when the arming pin is pulled and will activate the delay fuse when released. (AKA “spoon,” “safety handle.”)
ARMING PIN	A cotter (split) or solid metal pin, usually with a pull ring or cord loop, that holds the arming lever in place until pulled to release it or activate another arming means. (AKA “safety pin.”)
BLAST GRENADE	Grenade relying primarily on explosive blast and concussion to inflict casualties. Secondary fragmentation may be caused. (AKA “offensive grenade.”)
BODY (GRENADE)	The body – usually metal – containing the explosive charge or chemical filler and housing the fuse assembly. Other materials (concrete, ceramic, fiber, plastic) are occasionally used.
BOOSTER CHARGE	A small, high-velocity explosive charge initiated by the detonator to ensure the main charge detonates.
BRISANCE	The grenade body shattering effect of HE, causing fragmentation.
CASUALTY RADIUS	Generally, the specified distance from a detonating grenade, defining a circle within which at least 50 percent of the targeted personnel become casualties. Criteria vary greatly between armies and periods.
CHEMICAL GRENADE	Grenade filled with smoke-generating, incendiary, or irritant agents.
COOK-OFF	The act of igniting a grenade and waiting 2–3 seconds before throwing it to prevent the enemy from throwing it back before it detonates.
DEFENSIVE GRENADE	Grenade generating fragmentation and blast and required to be thrown from cover. (AKA “fragmentation grenade.”)
DELAY TRAIN	The burning-type time-delay fuse or element allowing safe detonation/ initiation of the grenade several seconds after arming.
DETONATING TRAIN	The series of fuse elements that detonate the grenade: primer (activated by the firing system), delay fuse, detonator, booster, and main explosive charge.
DETONATOR	A small explosive element detonated by the delay train to detonate the main explosive charge or initiate the chemical filler. (AKA “blasting cap.”)
FILLER	The grenade’s main explosive charge, incendiary, or chemical filler.
FILLER HOLE	A sealed opening in the grenade body into which the filler is inserted during manufacturing. Often this is the fuse well.
FRAGMENTATION	Irregular metal body fragments generated by the detonation of an HE-filled grenade. Incorrectly called “shrapnel” or “sharpmetal.”
FRAGMENTATION GRENADE	Explosive grenade intended to cause casualties by fragmentation of the body as well as blast effects. (AKA “frag grenade,” “defensive grenade.”)
FRAGMENTATION LINER	A metal lining inside the grenade body generating more uniform fragmentation.
FRAGMENTATION SLEEVE	A slip-on (add-on) pre-scored metal sleeve attached to a blast grenade’s body to generate more fragmentation.

FRICTION IGNITER

A pull-type device that ignites the delay train to ignite a pyrotechnic composition.

FUSE

The integrated assembly containing the detonator, arming, safety, and delay-train systems.

FUSE WELL

A threaded opening, usually in the grenade body's top, to hold the fuse assembly. Often doubles as the filler hole.

IMPACT-DETONATION

A grenade fuse intended to immediately detonate the grenade upon impact with the ground or an object.

OFFENSIVE GRENADE

Grenade relying on blast and secondary fragmentation to inflict casualties and permitting the thrower to be somewhat exposed. (AKA "blast grenade," "concussion grenade.")

PERCUSSION IGNITER

A fuse igniter activated by striking it on a solid object to ignite the delay train.

**PRACTICE, TRAINING, INERT,
AND DUMMY GRENADES**

Non-casualty producing grenades used in training and instruction. Exact definitions vary greatly between countries.

PULL RING

A metal ring (or cord loop) attached to an arming pin to make it easier to pull out of the fuse assembly.

PYROTECHNIC

Flammable chemical composition intended to create a flame or to generate colored smoke or flares for signaling purposes.

SECONDARY FRAGMENTATION

Fragmentation caused by an explosive detonation, but not from the grenade itself, but by nearby rocks, pebbles, wood, glass, etc.

SEGMENTATIONS

Scored or grooved cuts on a grenade body or attachable sleeve intended to aid in the generation of fragments. They do little to enhance this and were mainly added to ensure a firm grip on the grenade. Incorrectly called "serrations."

STICK GRENADE

A grenade with a throwing handle attached, which usually contains the fuse assembly.

A German MG 34 heavy machine gun team (*Maschinengewehr-Trupp*) readies their *Kaffemühle* (coffee mill). On the trench shelf are three Soviet RGD-33 stick grenades with add-on fragmentation sleeves, two Eihgr 39 egg grenades, and a Stg 24 stick grenade. (Courtesy of Concord Publications)



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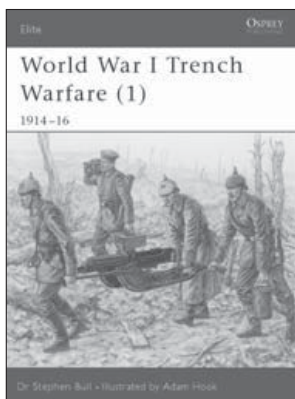
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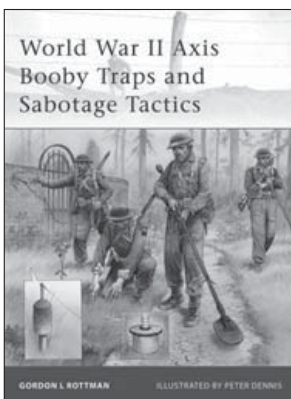
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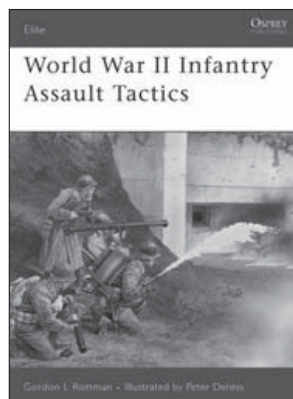
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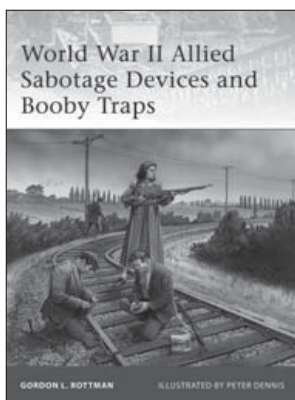
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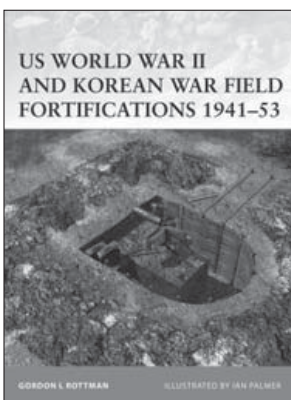
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Abbreviations

AT	antitank
Comp B	Composition B (high-explosive)
dB	decibel
frag	fragmentation
HE	high-explosive
illum	illumination
incen	incendiary
M, Mod, Mle	Model (Mle – French)
Mk	Mark
OD	olive drab
PE	plastic explosive
PETN	pentaerythrite petranitrate (high-velocity explosive used in detonators)
TNT	trinitrotoluene (high-explosive)
WP	white phosphorus (smoke and incendiary compound)

Official abbreviations for grenade models are described in the text.

Acknowledgments

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Imperial War Museum Collections

Many of the photos in this book come from the Imperial War Museum's huge collections which cover all aspects of conflict involving Britain and the Commonwealth since the start of the twentieth century. These rich resources are available online to search, browse and buy at www.iwmcollections.org.uk. In addition to Collections Online, you can visit the Visitor Rooms where you can explore over 8 million photographs, thousands of hours of moving images, the largest sound archive of its kind in the world, thousands of diaries and letters written by people in wartime, and a huge reference library. To make an appointment, call (020) 7416 5320, or e-mail mail@iwm.org.uk. Imperial War Museum www.iwm.org.uk

Front cover images are courtesy of Cody Images.

Title page: a US infantryman prepares to throw a grenade during training at Fort Belvoir, Virginia, in November 1942. (NARA 196462)

Editor's note

The cutaway illustrations on pages 15, 17, 19, 21, 27, and 33 are shown as large as possible and not to scale. In this book linear, weight, and volume measurements are given in US customary units of measurement (yards, feet, inches, pounds, ounces, grains, pints, foot pounds). The exception is weapons caliber, where metric is used in many cases, depending on the context. Where imperial units of measurement differ from US customary, the latter are used in the text. Conversions from metric into US customary are given in the text for clarity. The following data will help when converting between US customary and metric measurements:

1yd = 91.44cm
1ft = 30.48cm
1in = 2.54cm
1lb = 0.45kg
1oz = 28.35g
1 grain = 0.002oz
1 grain = 0.064g
1 pint (US liquid) = 0.83 pints (imperial)
1 pint (US liquid) = 0.47 liters
1ft lb = 1.36J